The Electrical Industry's Weekly Magazine

November 18, 1957

Electrical World

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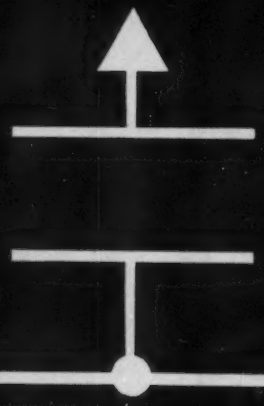

RELAYING & PROTECTION:

Standardize Relay Schemes and Settings...

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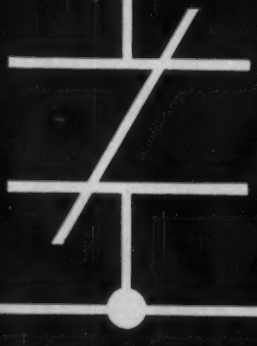

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... Load Control Boosts Continuity

Law of Supply, Demand Brings Reappraisal of Troubled Atomic Power Industry Page 75

E B POWER GS W
UNIVERSITY MICROFILMS I
313 N 1 ST
ANN ARBOR MICH

How General Electric engineers used Maine tides to help deliver 94-ton stator to coastal island

Intensive planning with Central Maine Power achieved safe, on-time delivery at new Yarmouth Station

TIDE WAS PUT TO WORK at Portland, Maine harbor to move pontoon barge close as possible to stator of 44,000-kw generator which had been shipped by rail from G-E plant at Lynn, Mass. Installation engineers waited for next high tide to float barge into Casco Bay, ready to start 8-mile trip.

LOW BRIDGE posed problem for 12-foot-high, 188,000-lb stator. As planned by G-E and utility engineers, the wait for low tide provided the necessary clearance and barge continued on voyage.

ISLAND LANDING was timed for high tide so that stator could be grounded as close as possible to specially built I-beam trailer which was to carry it on 1½-mile trip over Cousins Island.

18-FOOT-HIGH BANK had previously been bulldozed and planking put in place so trailer carrying stator could be moved.

TIGHT SQUEEZE had been anticipated by engineers for loaded trailer moved into Central Maine Power's new station with only 1-inch clearance on top.

The foresight and planning applied to this shipment is typical of the know-how which General Electric Installation & Service Engineering (I&SE) brings to each job. The unusual is routine to these G-E specialists who back up quality apparatus with the highest proficiency in installation and service engineering. Your General Electric Apparatus Sales Office will give you complete details on how any one of the 84 I&SE offices throughout the country can assist you. General Electric Company, Section 301-371, Schenectady 5, New York.

MORE POWER TO AMERICA

GENERAL ELECTRIC

Electrical World

Vol. 148, No. 21 November 18, 1957

Published for 83 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Features

CURRENT EVENTS

Lawyer and Salesman Take New Posts

Walter Bouldin, Alabama Power head, was counsel; Combustion Engineering's chief, H. G. Ebdan, salesman.....p 75

MEETING

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Atomic Industrial Forum hears too many makers, too few customers bring lower energy estimates, water-type reactor proposal .....p 76

RELAYING & PROTECTION

Load Control Boosts Continuity

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Standardize Relay Schemes, Settings

Standards developed by CEI replace "hand-tailored" methods without impairing performance.....p 86

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Oil Reclaiming Process Saves 10.5%

VEPCO neutralizes oil acids with trisodium phosphate before reclaiming with fuller's earth.....p 82

Insulator Stack Rated for 138 Kv

Stack gives utilities inherent economies when BIL exceeds 550 kv and substation space is scarce.....p 90

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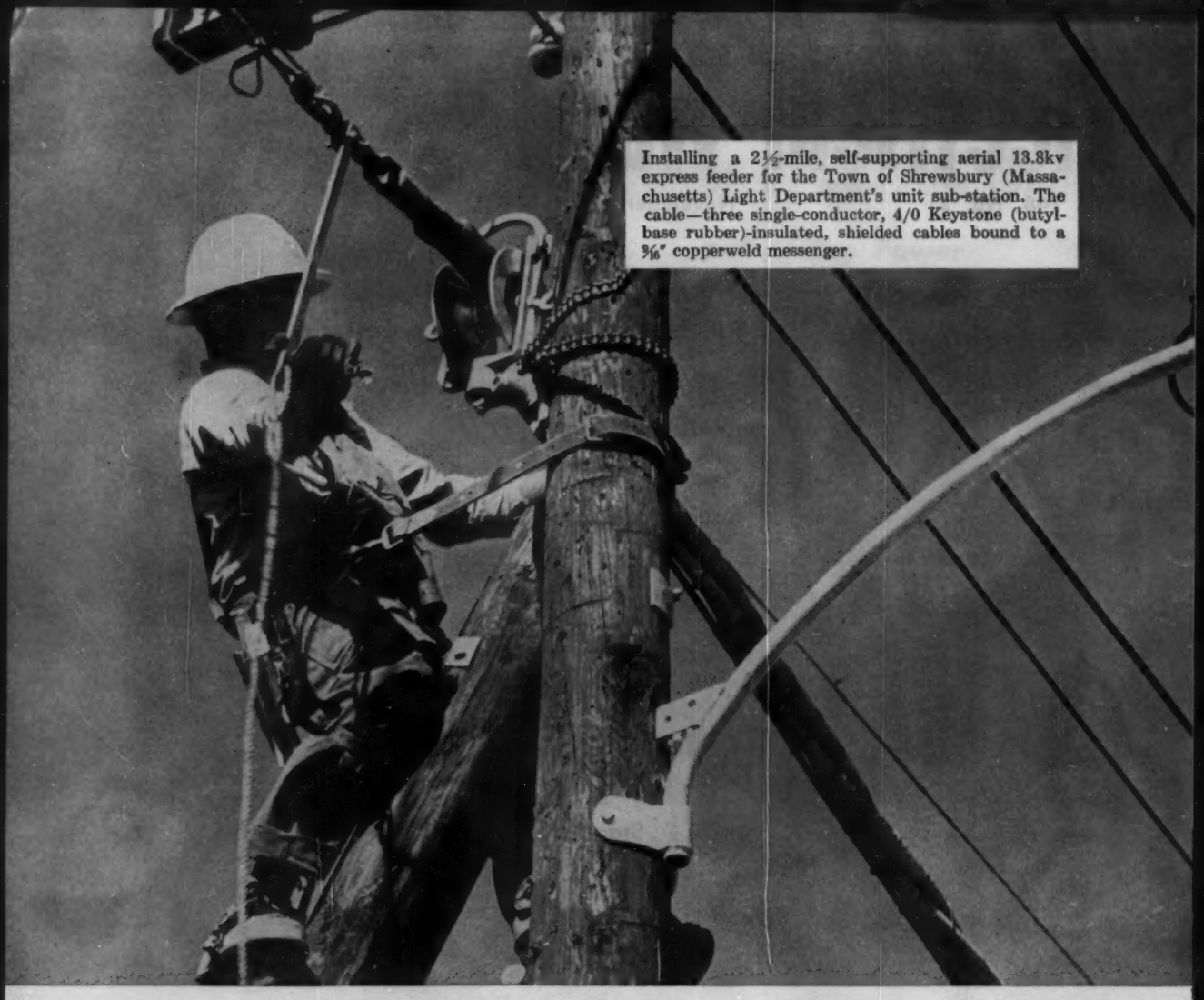

Installing a 2½-mile, self-supporting aerial 13.8kv express feeder for the Town of Shrewsbury (Massachusetts) Light Department's unit sub-station. The cable—three single-conductor, 4/0 Keystone (butyl-base rubber)-insulated, shielded cables bound to a 5/16" copperweld messenger.

Contractor: The Theodore D. Bross Line Construction Company

Modernize with Okonite self-supporting aerial cable...

The Town of Shrewsbury Light Department did just this when they recently installed a 13.8kv express feeder. They chose an Okonite self-supporting aerial cable because they wanted a superior installation that would practically eliminate tree trimming costs . . . be more reliable in storms (operate even with poles down) . . . reduce pole congestion . . . assure fewer interruptions or outages . . . have a moderate cost . . . provide improved voltage regulation because of lower reactance . . . and be more economical to operate and maintain than equivalent open wire lines.

In choosing Keystone (butyl-base rubber)-insulated cables for this important feeder, Shrewsbury Light Department was also banking on high voltage cable with a record for long and dependable service . . . high resistance to ozone and corona cutting . . . ability to take sharp bends . . . stable operation at copper conductor temperatures as high as 85C at 15kv . . . excellent resistance to moisture and extremes of temperatures.

For the complete story on Keystone-insulated cables, contact your Okonite representative . . . or write for Bulletin EW-463 where the results of field service and tests are reported with graphs and charts together with 36 pages of technical data.

The Okonite Company, Passaic, New Jersey.

where there's electrical power . . . there's **OKONITE CABLE**

4912

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. . . from the publisher

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Fischer Black

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now... you can sequentially record station operations automatically at less than one-third the cost

Now... the new F&P Millisecond Operations Recorder — MOR — brings the benefits of automatic sequential recording within every station's reach. Less than one-third the cost of previous methods, MOR pays its way in small remote substations as well as large generating stations.

Recording every change in trouble contact position on a permanent logsheet, MOR establishes the exact sequence and time of events . . . *even when they're only milliseconds apart.* And since it operates completely automatically, you can depend on MOR for a complete, continuous log, even under upset conditions.

The system consists of a completely separate 400-point capacity recording device, and cabinet. Systems with fewer than 400 points are easily expanded to ultimate size by inserting a single printed circuit card for each additional ten points. All cards are interchangeable and readily available from Fischer & Porter stock.

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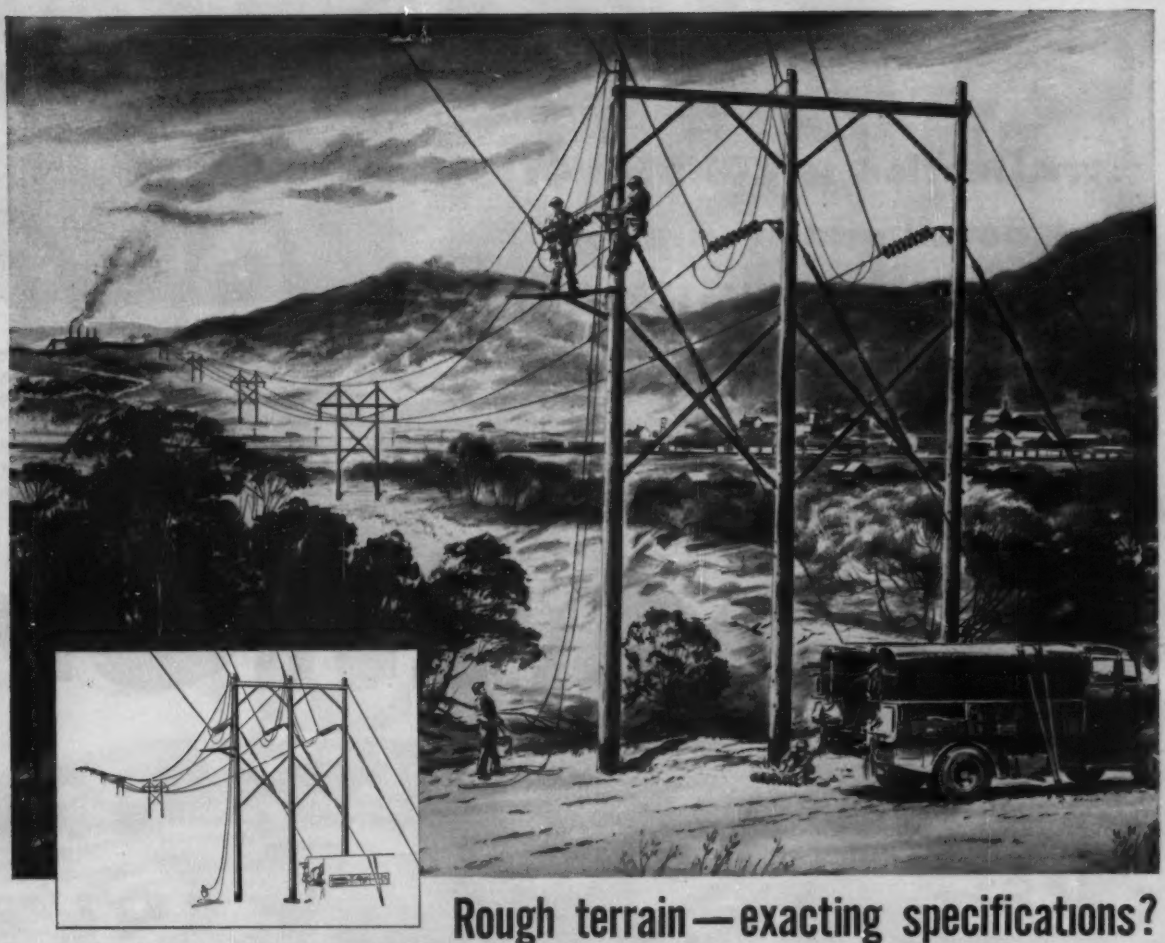
Complete Process Instrumentation



You can get prompt help with any outside construction problem through your Graybar office. In over 130 cities there are Graybar offices and warehouses ready to fill your every need for line materials, hardware and tools. And through any of these offices you can get the help of Graybar Outside Construction Specialists, strategically located in 19 principal cities, equipped by training and experience to give you prompt, dependable help.

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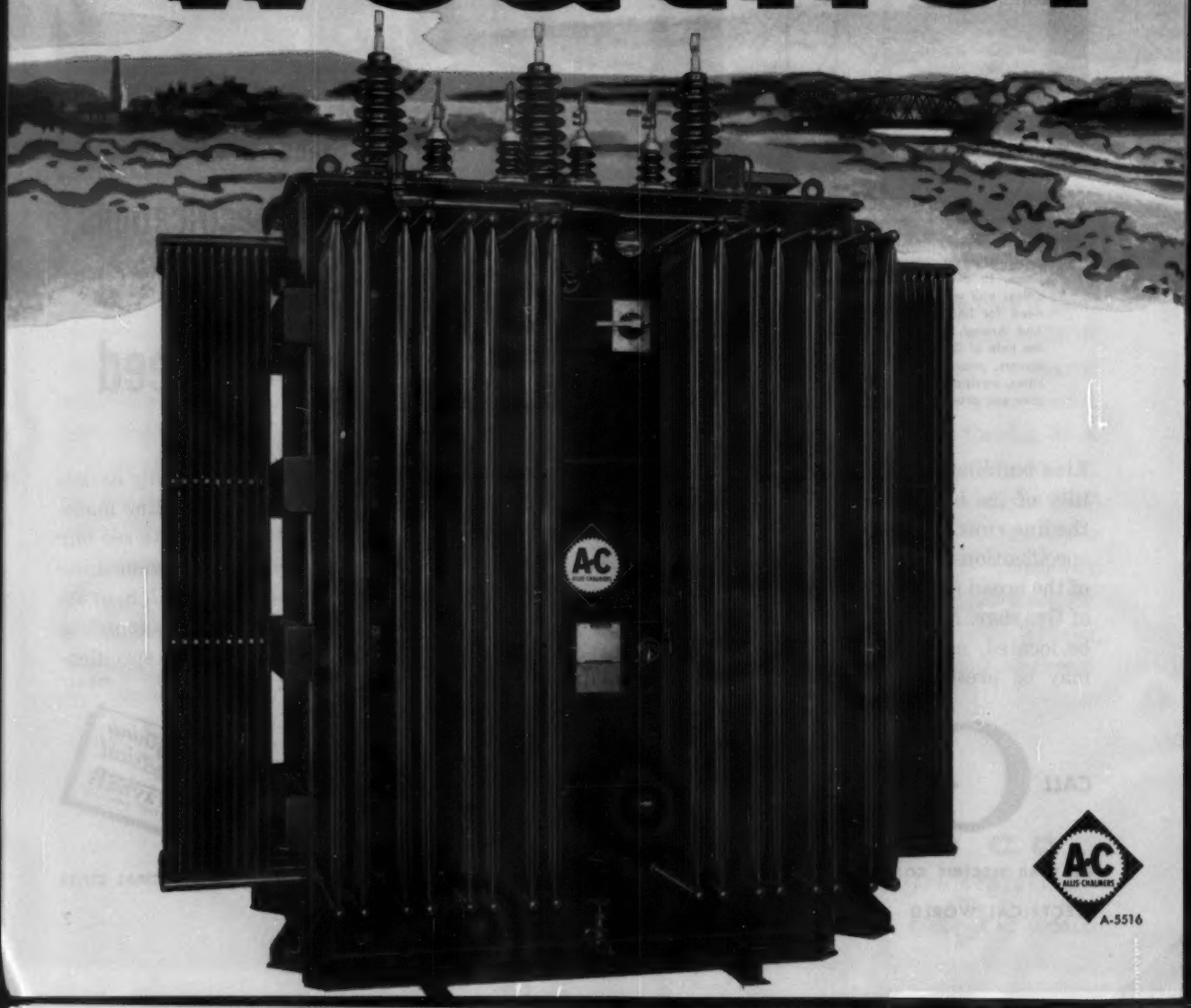
...Attention to **CONSTRUCTION** detail adds years to transformer life... reduces maintenance

Submerged arc welding machine welds tank sections together in a smooth, liquid-tight seam. In other welding operations, giant "mechanical hands" position tank so arc welding is performed downhand for maximum strength. Size of fillets, exact locations, electrode and heat specifications are all determined by design engineers.

ALLIS-CHALMERS power transformers are

weather



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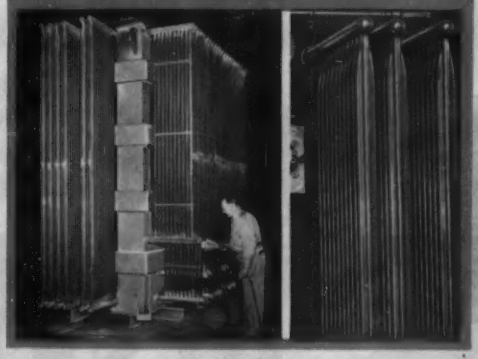


Welded-on radiators save time and money by simplifying installation. After welding is completed, transformer is sealed and pressure tested under extreme conditions. Fewer parts reduce maintenance. Nooks and corners where dirt and corrosion get in their destructive licks are eliminated.

Perfect seal provided by gasketing method for bolted cover. Gasket seat is accurately formed to confine the cork Neoprene gasket and control its compression. Welded cover is also available. Domed cover sheds water, to lengthen life of protective paint.

-tight

Balanced Design means

MORE for your Transformer Dollar

Weather-tight construction is another of the many features that make up the balanced design of Allis-Chalmers power transformers . . . features such as corona-free design, high impulse strength, uniform cooling, high short-circuit strength, reduced size and weight and many, many other features.

With power demands continually increasing, it is more important than ever to get assurance of dependability and long transformer life. For all the facts, call your nearby Allis-Chalmers office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

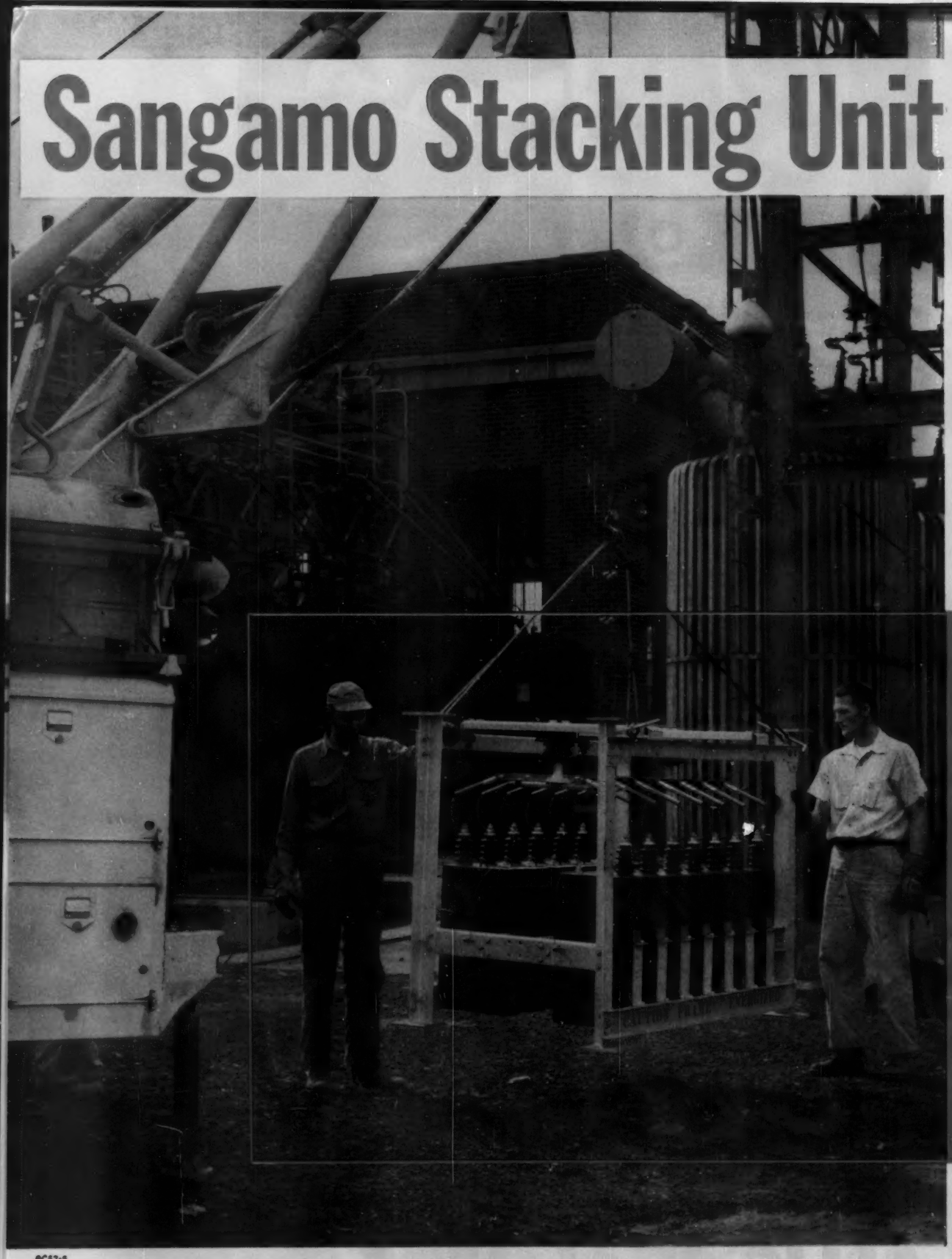
ALLIS-CHALMERS

Check these conveniences too!

Ample jacking space makes installation quick and easy. Practically any type jack may be used.

Ski-shaped base of heavy I-beam cross supports makes it possible to skid transformer in any direction.

Sangamo Stacking Unit



8C57-S

Typical 700 Kvar NEMA Standard Sangamo Unit swings off the truck to add Kilovars at the lowest possible cost.

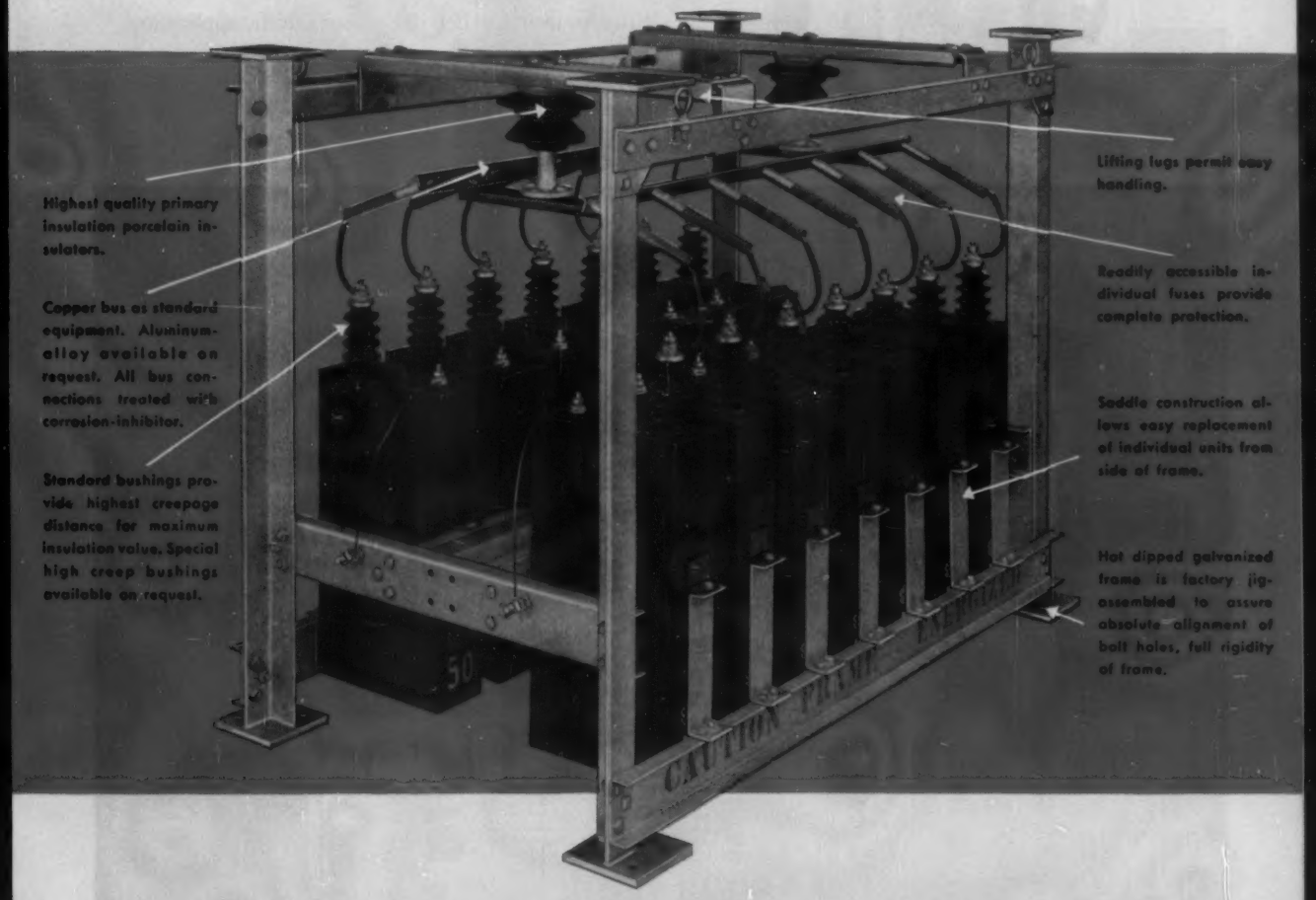
Capacitor Equipments

cut installed kilovar costs to the minimum!

Sangamo primary power capacitors are now available in factory-assembled stacking unit equipments. Ready to install at key points on your system, they can supply large blocks of kilovars at lowest installed cost per kilovar.

Here's why . . . the unit type design saves you man-hours and construction costs. Equipment designs provide additional savings on footings, base support insulators and connecting materials. Equipments assembled with 50 Kvar units put maximum Kvar into the smallest space.

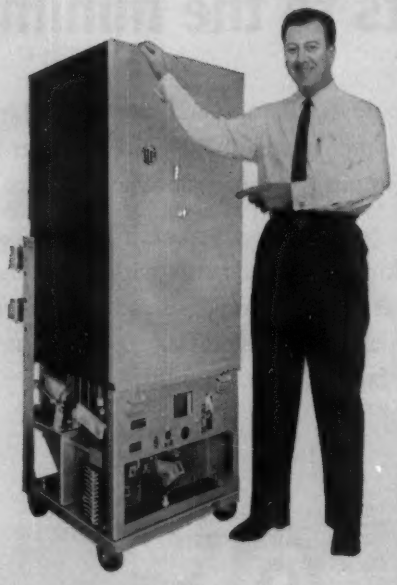
Save cost, time, and space in your substation by stacking your kilovars with Sangamo Equipments. NEMA standard racks are furnished as standard catalog items. Special designs are available on request.


Highest quality primary insulation porcelain insulators.
Copper bus as standard equipment. Aluminum-alloy available on request. All bus connections treated with corrosion-inhibitor.
Standard bushings provide highest creepage distance for maximum insulation value. Special high creep bushings available on request.
Lifting lugs permit easy handling.
Readily accessible individual fuses provide complete protection.
Saddle construction allows easy replacement of individual units from side of frame.
Hot dipped galvanized frame is factory jig-assembled to assure absolute alignment of bolt holes, full rigidity of frame.

SANGAMO ELECTRIC COMPANY

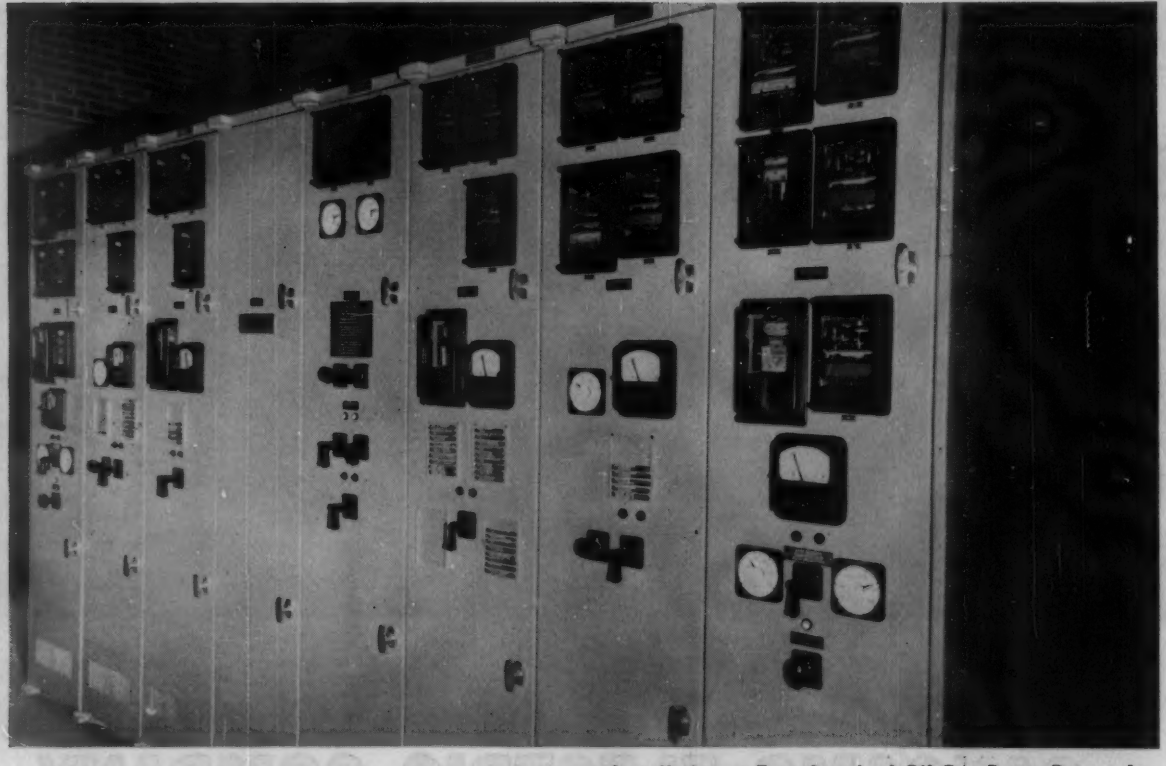
SPRINGFIELD, ILLINOIS

First 5 kv Breaker in



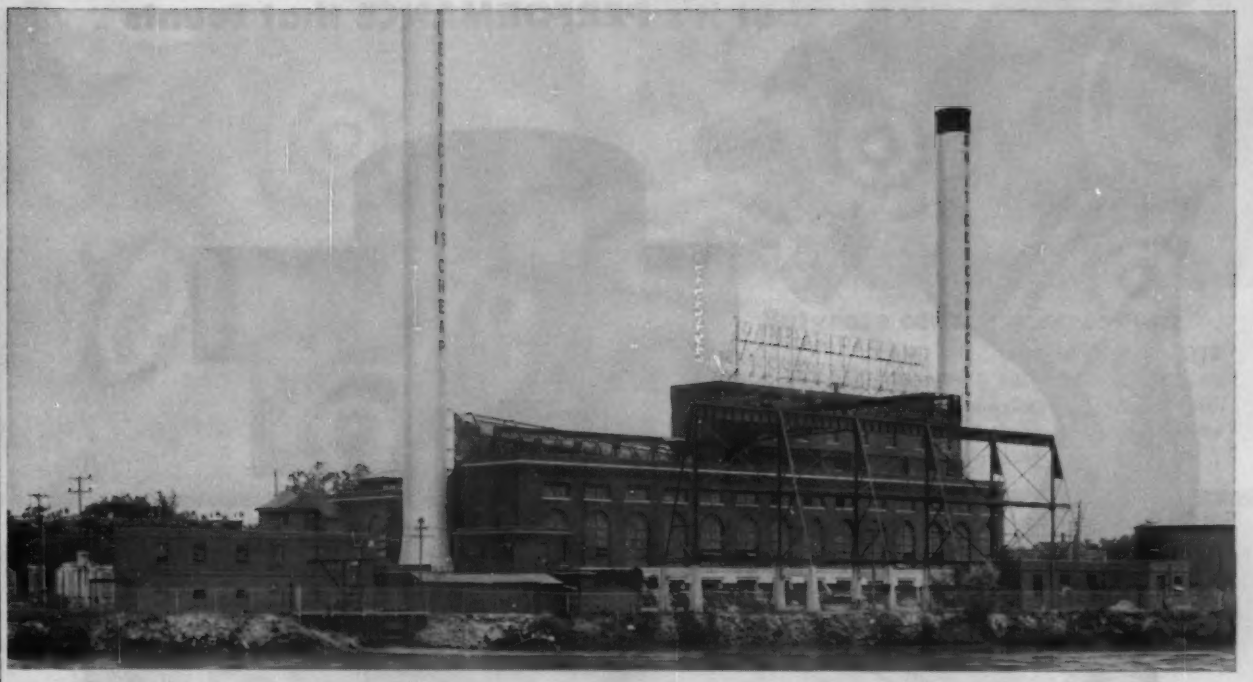
I-T-E leads again. Three installations already. More coming soon.

First 350 mva air magnetic circuit breakers to be developed in the 5 kv class. First to be installed. First to be operating. This latest electrical progress reflects I-T-E's constant effort to extend the ratings of modern metal-clad switchgear. And as with all I-T-E equipment, these new circuit breakers are made with I-T-E's traditional emphasis on sound engineering and quality construction. Available now in 1200 and 3000 amp continuous current ratings. Write for technical details on your specific application.

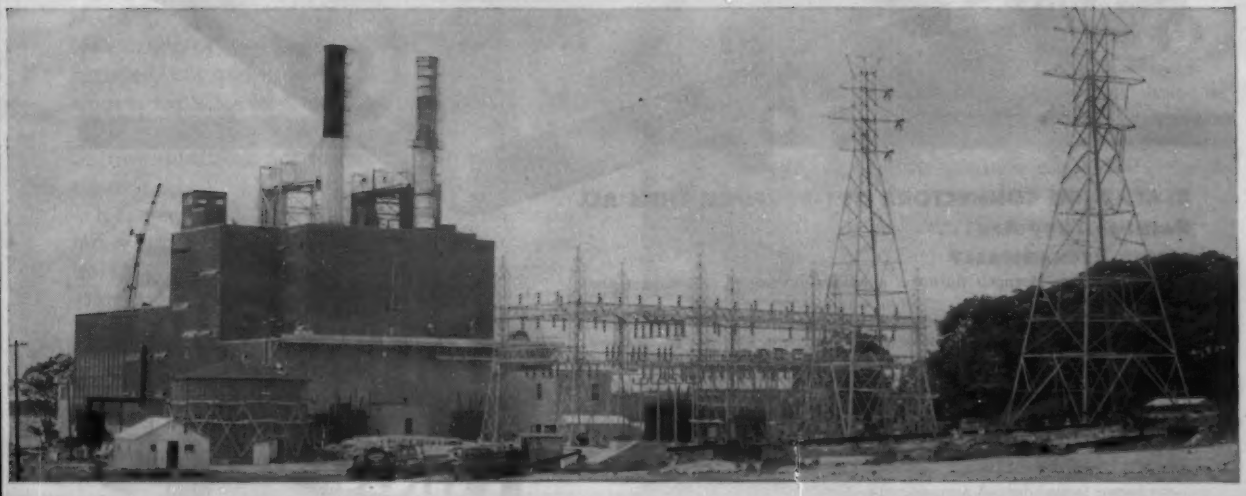


Installation at Esso Standard Oil Co., Baton Rouge, La.

350,000 kva Rating



Kansas Gas and Light Co., Wichita, Kans.



Central Maine Power Co., Augusta, Maine

I-T-E

SWITCHGEAR DIVISION

I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STREETS, PHILADELPHIA 30, PENNSYLVANIA

There IS a Difference!

Connectors may look alike but it's PERFORMANCE that counts

BLACKBURN CONNECTORS OUT-PERFORM THEM ALL

Because They Are...

BETTER MECHANICALLY

- Made of high strength duronze, a silicon bronze alloy stronger than structural steel.
- Machine cut threads, *CFC treated, provides more thread engagement —reduces friction and increases thread efficiency. *Chemical Friction Control.
- Rigid inspection of each production operation assures uniformly good connectors.

BETTER ELECTRICALLY

- High clamping force—the result of greater thread efficiency breaks down oxide on the conductor improving conductivity.
- Higher initial conductivity, actually greater than an equal length of conductor is maintained permanently.

REUSABLE

- Selection of proper high-strength, corrosion-resistant materials—plus precision workmanship and inspection—means Blackburn connectors may be used over and over.

BLACKBURN *Hi-Strength* CONNECTORS

AVAILABLE AT ELECTRICAL WHOLESALERS EVERYWHERE

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Butyrate conduit is joined easily

Using slip-sleeve couplings and solvent cement, two Kingsport Utilities crewmen laid 247 feet of a "white way" line in only 20 minutes—a fraction of the time it would take with conventional materials.

Butyrate conduit curves without fittings

To follow ditch contours in this installation, Brookville Telephone Company, Brookville, Indiana, used semi-rigid conduit of Tenite Butyrate—and eliminated the need for many right angle fittings.

You get extra advantages with conduit of Tenite Butyrate plastic

Conduit made of Tenite Butyrate plastic is ideally suited for your operations.

It has a horn-like toughness and high impact strength. It is unaffected by corrosive and electrolytic action of soil, and is non-inductive. It can be handled, cut and joined with ease. It has glass-smooth walls for easy cable pull-through.

But conduit made of Tenite Butyrate also offers unique qualities not found in any other cable conduit.

It is semi-rigid. This allows the engineer to plan many direction changes—*without fittings*. It is available in long 20-foot lengths to reduce the number of joints in your line. It is extremely light in weight; a length of 4" conduit weighs only 20 lbs.

For more information and the names of manufacturers supplying conduit made of Tenite Butyrate plastic, return the coupon below.

1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

Butyrate conduit resists corrosion

Tenite Butyrate was chosen by Community Public Service Company as the duct material to successfully combat the strong alkali soils found in the Pecos, Texas area.

TENITE
BUTYRATE
an Eastman plastic

EASTMAN CHEMICAL PRODUCTS, INC.
subsidiary of Eastman Kodak Company, Kingsport, Tennessee

Please send me information on cable conduit made of Tenite Butyrate and a list of companies manufacturing Butyrate conduit and fittings.

NAME_____
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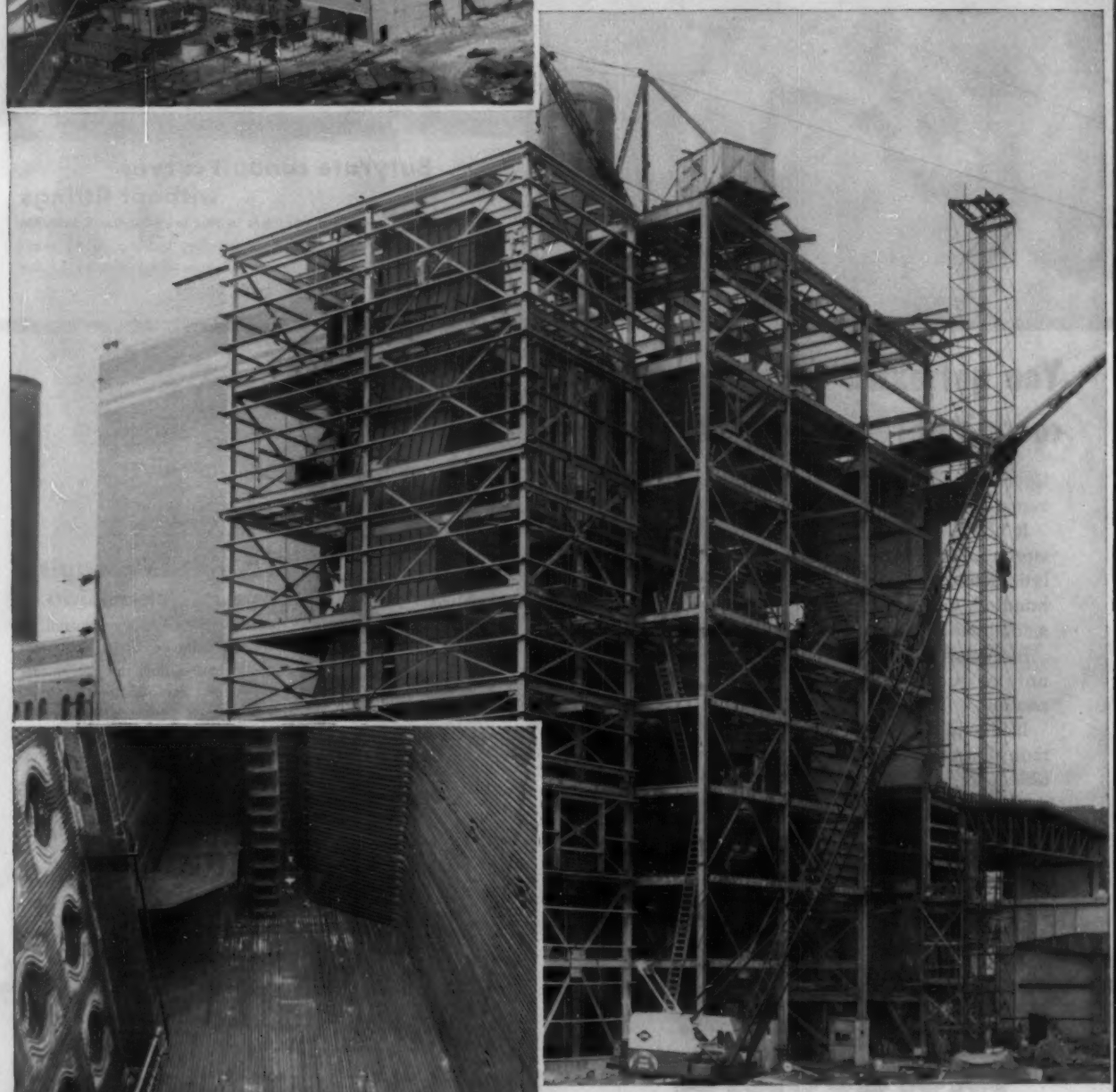
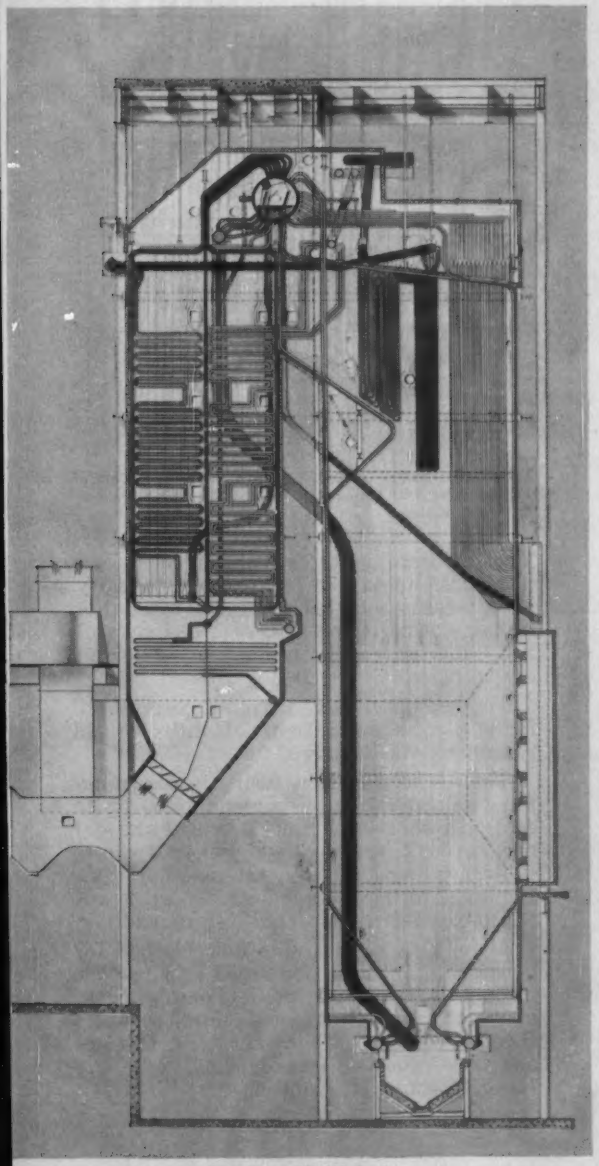
COMPANY_____
STREET_____
CITY_____ ZONE_____ STATE_____

This is R. S. Wallace Station showing modern enclosure for Unit No. 6, a 600,000 lbs./hr. Riley Boiler. Below, Unit No. 7 under construction.



Inside furnace of Unit #7 at E. Peoria. At left — 5 of 16 Riley Flare Type Burners; burner openings are water-cooled. Top left — one of two bare tube platens that are employed to evenly distribute furnace heat across superheater and reheater.

Sixth RILEY Boiler at R. S. Wallace Station



Capacity — 690,000 lbs/hr.
Drum pressure — 1650 psig
Superheat, Reheat — 1000 F
Fuel: Central Illinois Coal
Average Overall Efficiency — 87.7%
COMMONWEALTH ASSOCIATES, INC.
CONSULTING ENGINEERS

CENTRAL ILLINOIS LIGHT COMPANY has also ordered its EIGHTH Riley Boiler for its Lamarsh Station

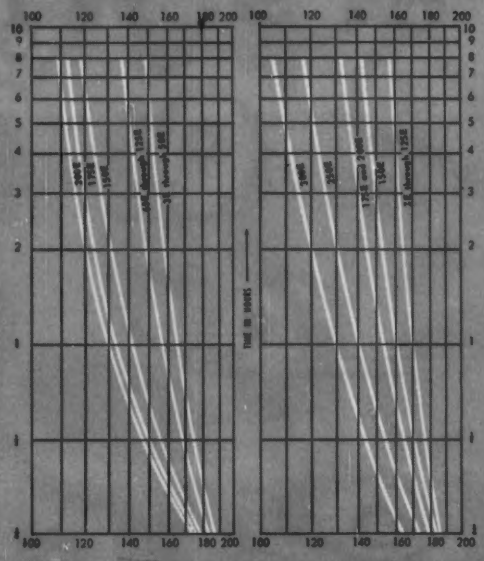
Since 1939, Central Illinois Light Company has installed six Riley Boilers in its East Peoria R. S. Wallace Station. The latest, a 690,000 lb/hr Reheat Unit is illustrated here and will shortly go on the line. The recent order of an 850,000 lb/hr Reheat Unit for Lamarsh Station will bring the total of steam generated by Riley boilers to 3,415,000 lbs/hr. Dependable operation, and high availability are the operating characteristics of these Riley boilers.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs. .

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

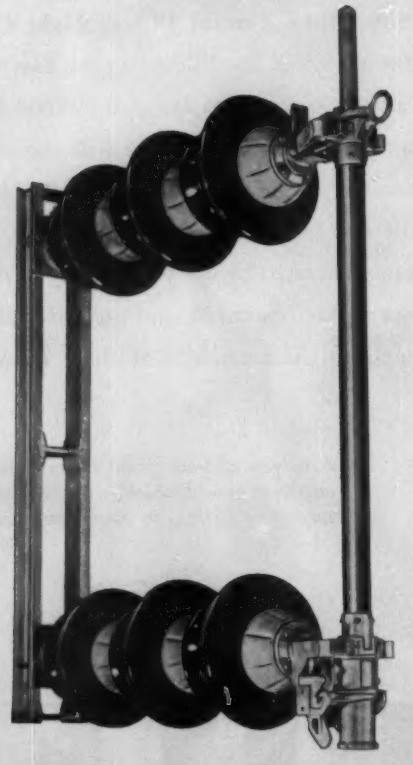
short-time emergency overload capability for SMD Power Fuses



Load Current in Per Cent of SMD-1 Fuse Unit Ampere Rating

Load Current in Per Cent of SMD-2 Fuse Unit Ampere Rating

now... even for overloads you can match power fuses to power transformers



The pressure is on to obtain maximum utilization of power transformer capacity. This pressure has led to precise evaluation of transformer short-time overload capabilities—for both daily peaks and occasional emergencies.

To keep pace, S&C has made correspondingly precise evaluations of the overload capabilities of its power fuses.

The result: (1) New fusing tables (minimum ampere rating recommendation) which recognize short-time daily overload and (2) new curves (see above) which permit you to subject power fuses to extreme short-time overload during emergencies, as when one transformer picks up the load of another.

All of this is part of a new method for power fuse selection contained in a 16-page package—Data Bulletin 262. For your copy, write to S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

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S&C ELECTRIC COMPANY

NEWS-SCOPE

FUTURE NEWS ▶ **Look for AEC approval of Carolinas Virginia Nuclear Power Associates' proposed prototype reactor** by the first of the year. Site for the $17-million plant has just been selected at Parr Shoals on the Broad River, 25 mi north of Columbia, S. C. and adjacent to SCE&G's Parr Shoals hydro and steam plants. Slated for 1962 operation, the facility would be of the heavy-water-cooled and heavy-water-moderated pressure type, using slightly enriched uranium.

More utilities, including several in the East, plan to install power and gravity conveyors to speed and cut the cost of routine handling of meters in the test shop.

Yankee skepticism toward electric heating is about to suffer another setback: a prominent New England company is considering going to a special rate for its promotion. This added geographical spread among heat-conscious utilities belies the notion that electric heat will flourish only in the South.

LATE NEWS ▶ **Arkansas Louisiana Gas may build electric power plants to retaliate** against what it sees as an electric utility invasion of their winter heating business. Referring to recent federal decision to use heat pumps instead of gas in 1,535 homes at Little Rock Air Force Base, Board Chairman W. R. Stephens said if power firms "compete for the heating load with statements about 'cheaper fuel,' there's nothing for us to do but construct generating plants and make electricity . . . and sell it to anyone who wants it." (See also EW, Oct. 21, p 19).

BPA will hold to its basic rate of $17.50 per kw/year until December, 1959, at least, reports Administrator William Pearl.

Soviet scientist invents procedure for direct transfer of atomic into electrical energy by means of certain semiconductors. So reports "Balinski Rabotsch," the newspaper of Communist Central Committee of Aserbaidschan.

Newly elected president of National Electrical Manufacturers Assn is W. V. O'Brien, VP-general manager, apparatus sales, at General Electric. He succeeds A. A. Berard, Ward Leonard Electric president . . . NEMA also elected three new vice presidents: A. D. R. Fraser, Rome Cable president; F. H. Roby, Square D's VP-sales; and J. C. Sharp, Hotpoint president-general manager . . . Reelected vice presidents are J. L. Singleton, Allis-Chalmers Mfg vice president; and N. J. MacDonald, Thomas & Betts president . . . In addition, B. C. Neece, president of Landers, Frary & Clark, was named treasurer to succeed F. F. Loock, Allen-Bradley president.

Congratulations . . . James E. Bullock is new president of Fall River (Mass.) Electric . . . Arkansas P&L ups P. E. McChesney to vice president . . . Eta Kappa Nu has named Robert P. Crago of IBM as Outstanding Young Electrical Engineer of 1957 . . . New VP's of Allis-Chalmers are W. M. Wallace, P. F. Bauer, and E. J. Mercer.

ELECTRICAL WEEK

A TWO-MINUTE

ATOMIC PROGRESS ▶ **Supply and demand has snared the atom,** industry conditions suggest. There are more plant manufacturers than customers. The result is a downward revision of 1968 capacity predictions from 10,000 to 6,000 Mw, maximum. The atom is also bucking high capital costs. A new atom power plant today costs $430/kw. By 1968, A-plants may range from $280 to $360/kw. Fuel-cost outlooks are not much brighter, with slightly enriched uranium water-reactor fuel pegged for the late '60's at 3 to 5 mills/kwhr. Conventional plants run 2.6 mills today. With most major utilities plunged into atomic development up to their financial chins, more government projects are in the wind. Fresh looks at the development situation have produced suggestions that we concentrate on water reactors, on large-scale installations, and on building abroad (p 76).

WASHINGTON ▶ **FPC has approved Idaho Power's Hells Canyon financing plan,** over two Senators' objections . . . TVA has a new board member—University of Kentucky's Frank J. Welch (p 72).

MEETINGS ▶ **Upward pressures on utility rates can be eased by operating** with "long term" perspective. Building plants for ultimate usage instead of immediate needs can lower the ultimate kwhr/building dollar ratio. But most means to long-term economy require heavier financial risks and reduced present earnings—burdens which require an adequate earning structure (p 73).

SYSTEM PLANNING ▶ **Supplying TVA power with maximum continuity and economy** demands relaying to isolate deficient areas, shed load, and protect equipment. Short- and long-range planning for generation and tie line scheduling are other prime considerations (p 84).

TRANSMISSION ▶ **New 138-kv switch and bus insulators are satisfactory substitutes** for four-unit 161-kv stacks often used on 138-kv systems. The new combination of two TR 140 insulators with TR 53 unit on top cuts weight 65 lb/stack, permits shorter switch bases and switch arms, lower clearances, and greater cantilever loadings (p 90).

DISTRIBUTION ▶ **You can supply 4-wire 120/208-v service** with two phases of a wye by connecting two normal size transformers for 120-v operation and one of about twice normal size for 120/240-v (p 95).

RELAYING ▶ **Revamping distribution relaying methods** at Cleveland Electric Illuminating Co has paid off in better coordination of engineering design with protection of distribution feeders. New relay setting standards eliminate separate calculations for each feeder (p 86).

CONSTRUCTION ▶ **Transporting building construction workers on a conveyor-type lift** chops about 7 min off basement-to-roof travel time (p 95).

PREVIEW OF THIS WEEK'S ELECTRICAL WORLD

SUBSTATIONS ▶ **This new way of reclaiming insulation oil knocks 0.8¢/gal off Virginia Electric & Power's reclaiming and inhibiting bills. That's a 10.5% saving. The 11-step process includes washing the oil with TSP and water to remove acid, draining, reclaiming with fuller's earth, and inhibiting with an artificial anti-oxidant. Unlike other TSP washing processes, this one requires no heating or large amounts of water (p 82).**

SELLING ▶ **Working showcase—that's what Southwestern Public Service made of its new office space, converted from a garage next to the general office. One side of the passageway between the two buildings is an appliance display case. Glass walls on the other side reveal heat pumps and electrostatic air cleaners at work conditioning the new facilities. Fluorescent lighting tailored to each work or lounge area sets an example for customers (p 98).**

HEATING & COOLING ▶ **Heating schools electrically may become a trend. There's lots of advantages, and lots of activity pushing them. Indiana & Michigan Electric System will soon have eight schools on the lines, having sold itself and the schools on the benefits. And the Pacific Northwest is fast shaping up into a hot market, with several manufacturers giving the trend a big promotional push (p 100).**

FINANCE ▶ **Money market is easing, but don't expect Federal Reserve Board Policy to follow suit. Its loosened up very little (p 113).**

PEOPLE ▶ **"Bigness Factor" challenges utilities in future efforts to meet mammoth loads, says Combustion Engineering's new president, H. G. Ebdon. To meet future power demands, he feels, utilities will have to expand grid tie-ins, capitalize on existing plant sites and move closer to fuel sources, pay more attention to distribution, and boost rates. Building bigger boilers is largely a financial, not technical, problem for the manufacturers. They will need progress-payment support from utilities (p 75).**

Rochester Gas & Electric appoints Robert E. Ginna chairman of the board and chief executive officer to succeed retiring Alexander Beebee. Also: Ernest J. Howe becomes president, and Leo H. East executive VP . . . Southern Co elects Clifford B. McManus chairman of the board (p 125).

MANUFACTURERS ▶ **The new Electrical Insulating Materials Assn plans to speed the flow of information between insulation manufacturers and users . . . NEMA has formed a pole line hardware subdivision (p 113).**

NEW EQUIPMENT ▶ **Transformers have newly designed panel radiators which increase tank wall strength, are easier to clean and repaint, and require less space than flat-tube or chimney-types (p 106).**

ENGINEERING TRENDS

Transformer noise at a residence less than 50 ft away is ground-borne as well as air-borne. Even though a total enclosure is provided, it may be necessary to mount the transformer on vibration insulators to cut the ground-borne component of noise.

Functional testing appears likely to be used for cable much as it has been adopted by transformer engineers, according to proposals made by several cable engineers. Gist of their thinking is that test samples often indicate a dielectric strength considerably better than that attained when cable is placed in a typical installation. And functional testing to simulate actual service, accelerated by overvoltage, gives a better index of service life.

Rate of increase in initial power plant steam temperature will slow down because new low cost, high temperature metals are not yet available. And the point of diminishing economic returns even for very large capacity units may be attained after 6,000 psig initial pressure is reached.

Additional power may be available to power plants using natural gas delivered by high pressure gas lines. If the incoming gas is heated and put through a pressure-reducing gas turbine, power can be delivered to the axuiliary bus at a net heat rate of better than 3,000 Btu per kwhr.

Radiation-resistant lubricants have been developed for nuclear power plants but they will be approximately 10% more costly than ordinary lubricants now used in conventional power plants.

For cooling towers up to 250 ft in length orientation of the long axis of the tower parallel to the prevailing wind is preferred. Towers longer than 250 ft should be arranged broadside to the prevailing wind.

Split boiler feed pump schemes give slightly higher thermal efficiencies than single-pump schemes according to a recent article in COMBUSTION. In addition, with a split-pump arrangement not all the heaters are subjected to full boiler pressure. This offers definite economic advantages.

FROM EDITORS IN THE FIELD

Pressurizing the inside of a switchhouse with ½-in. water pressure keeps dust out of the Alabama Power Co's switchgear.

Soon to be announced is a new insulating varnish designed to meet high temperature requirement (155C) at low cost. It is expected that the price of this insulating material will be less than half the cost of varnishes used with Class H insulating systems and only slightly more than those used in the lower Class B.

THE NEW L-M ULTRA-VALVE intermediate-class lightning arrester, mounted in a substation. This new unit is extremely effective, light, and compact.

Construction is simple, rugged, and durable. The design insures stability of operation, and offers wide flexibility in application.

Line Material Announces the New Ultra-Valve— A Marked Improvement in Lightning Protection

The L-M Ultra-Valve is a new intermediate-class lightning arrester, developed by the leading manufacturer of valve-type distribution arresters.

The new Ultra-Valve arrester has many advantages. Electrical characteristics are excellent. It is extremely simple, rugged, and durable.

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

McGRAW EDISON

Simple Series Gap and Valve Disc Design . . .

New Ultra-Valve Intermediate-Class Arrester Provides Greater Protection, Cuts Costs

By **H. O. STOELTING**
Special Assignments Engineer, Protective Devices
Line Material Industries

Trends toward higher voltages, higher kva ratings, and tighter substation space have increased the need for a light, compact intermediate arrester with a desirably low protective level and greater discharge capacity.

As the leading manufacturer of valve-type distribution arresters, Line Material has been in probably the best position in the industry to develop a new arrester that would meet the need. Our new Type F arrester, the Ultra-Valve, is our answer to the problem.

This new arrester consists basically of a series of gap-and-valve units, held under compression by a single heavy-duty coil spring. This results in an extremely effective arrester that is also quite rugged and durable. Its compact design saves space and should reduce construction costs.

The gap units combine a new and fundamentally different pre-ionized series gap and resistor ring with unique ceramic-bonded valve discs. Under surge conditions, the pre-ionized gap and resistor ring trigger the main gap, resulting in a low and consistent impulse sparkover. Thus the arrester operates quickly and dependably on all types of surges.

Better Protective Level

Each individual gap assembly in the Type F arrester is shunted by a non-linear resistor ring which insures uniform power-frequency voltage distribution across the gap. The shunt eliminates any voltage unbalances caused by external conditions, such as surface deposits or rain. Power-frequency sparkover values are above the minimum industry standard of 1.5 times the arrester rating and are virtually the same under wet or dry conditions.

The balanced design of the new Type F arrester limits 60-cycle power follow current to exceptionally low values, regardless of system capacity.

Durability Thoroughly Tested

The new Type F Ultra-Valve arrester easily exceeds all minimum requirements for intermediate-class valve arresters, as published in ASA Standard C 62.1-1957. It is capable of discharging surge currents in excess of 100,000 crest amperes having a 5 x 10 microsecond wave shape.

Duty-cycle tests show that the Ultra-Valve is capable of discharging a 10,000-ampere, 10 x 20 microsecond surge more than 20 times, with rated power-frequency voltage applied. It also has the ability to withstand more than twenty 150-ampere discharges of 2000 microseconds duration.

A single strong compression spring holds the series of gap and valve elements in position. Parts cannot get out of alignment. Rugged construction of all parts insures long arrester life and prevents shipping damage.

Cuts Construction Costs

Mounting is simple and inexpensive. The arrester is compact, light, and self-supporting. It can be mounted in various ways—directly on a transformer, bolted to the substation structure, on a cross arm or on a suspension hanger. A choice of brackets is available. Line and ground connections can be very short, providing maximum protection.

LM® **LINE MATERIAL**
McGRAW-EDISON COMPANY

Two-bolt terminals accommodate wire sizes from No. 6 solid through 400 mcm. Terminals are tin-plated.
Light-weight aluminum-alloy end castings are cemented to the separately and permanently sealed arrester unit.
Permanent moisture-proof seal at each end of the housing is a heavy synthetic rubber gasket compressed between the stainless steel cap and accurately turned porcelain seat.
Heavy compression spring holds column securely in place.
Ceramic resistor rings provide proper spacing and equal voltage distribution between the gap electrodes.
Valve discs and spark gaps are alternated throughout the arrester. Contact surfaces of the valve discs are metal-coated to assure uniform current distribution throughout the valve material.
Plastic tape is wound around the cylindrical surface to cushion the valve disc against contact with the housing.
High-grade, wet-process porcelain housing offers good insulating value. Petticoat design and uniform glaze facilitate self-cleaning when the arrester is exposed to dirty atmospheres.
GAP ELECTRODE
RESISTOR RING
GAP ELECTRODE
VALVE DISC
GAP ELECTRODE

Complete Line of Intermediate-Class Arresters

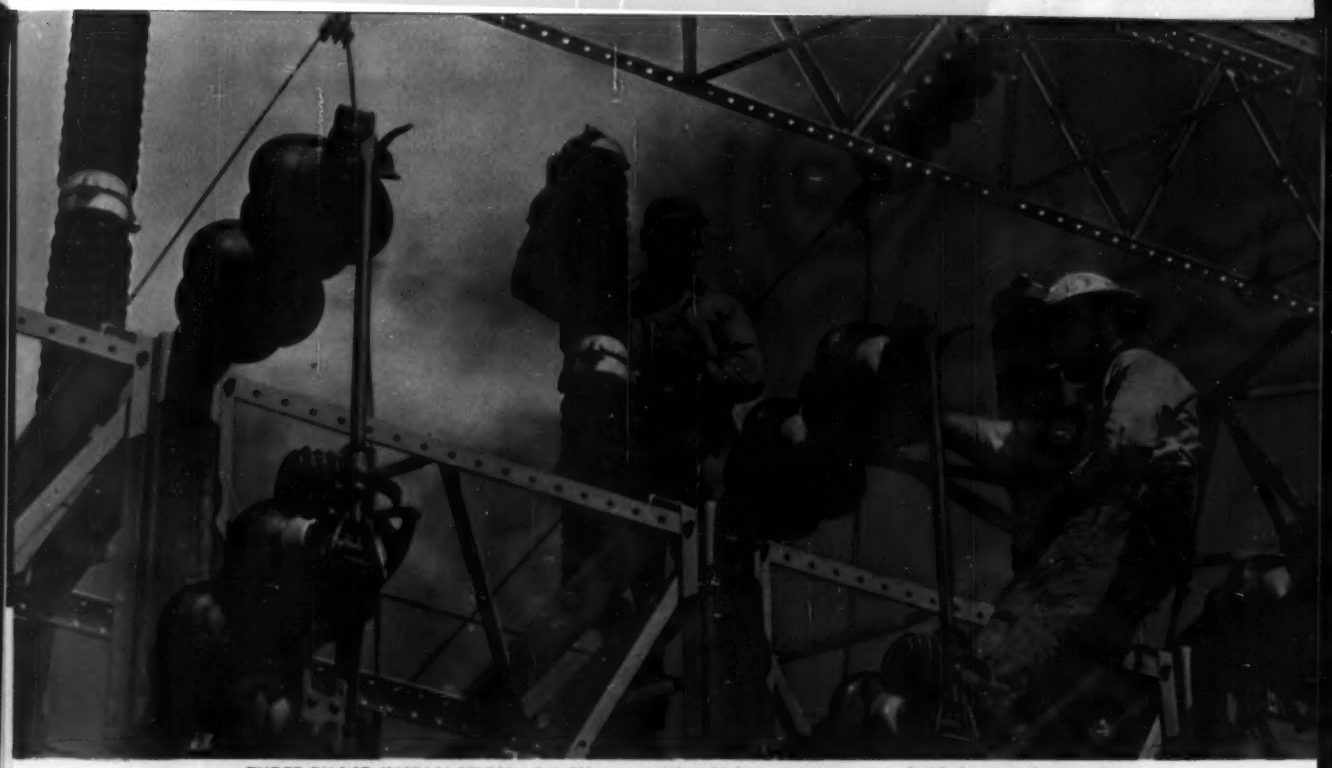
L-M's new Type F Ultra-Valve intermediate-class arrester is available in all standard ratings 20 kv through 73 kv. 3 kv through 15 kv and 90 kv through 121 kv will be available soon.

NEW TYPE F ULTRA-VALVE arrester is compact, light, self-supporting. Easy to mount directly on transformer or substation structure.

KV	Height	Weight	KV	Height	Weight
20 kv	17½	44 lbs.	40 kv	35	88 lbs.
25 kv	21	53 lbs.	50 kv	42	106 lbs.
30 kv	24	62 lbs.	60 kv	48	124 lbs.
37 kv	29	75 lbs.	73 kv	58	150 lbs.

Industries Lightning Arresters

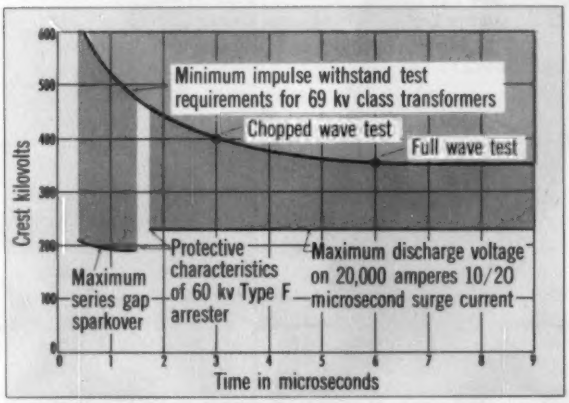
McGRAW EDISON



THREE-PHASE INSTALLATION of L-M's new Ultra-Valve arresters, rated 60 kv maximum, in a 69 kv substation. The arresters are light and compact, and have outstanding electrical characteristics. The arresters can be tank mounted to save space and shorten line and ground connections.

Wider Coordination Range Provides Greater Flexibility, Reduced Impulse Stress

Coordination of L-M's new Type F Ultra-Valve arrester with power transformers and related equipment



Impulse volt-time coordination curves for 69 kv grounded neutral system showing how L-M's new 60 kv Ultra-Valve arrester provides a large margin of protection for 69 kv class transformers.

is very good for both lightning and switching surge conditions.

The exceptionally low sparkover and discharge voltages of the Ultra-Valve provide a wide coordination range. This results in reduced stress on the protected equipment and minimizes the possibility of equipment damage caused by a severe stroke of lightning. This is particularly valuable for application on sub-transmission systems that do not have an overhead ground wire or shielding.

The Type F Ultra-Valve arrester also provides more flexibility. The greater zone of protection permits wider separation between the arrester and the protected equipment without decreasing the protective level beyond that which is possible with obsolete arresters at much shorter spacing.

Get Complete Information

Ask your L-M Field Engineer for more information on how L-M's new Type F arrester can provide greater lightning and switching surge protection on your system. Or write Line Material Industries, Milwaukee 1, Wis.

LINE MATERIAL Industries

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Lightning Arresters

NEW ALUMINUM SUBSTATION STRUCTURE BOOKLET

SHOWS HOW TO CUT COSTS, REDUCE MAINTENANCE AND IMPROVE APPEARANCE WITH ALUMINUM

How does the cost of aluminum compare with that of steel in corrosive marine and industrial atmospheres? Do you think aluminum costs more? Actually, it costs *less* . . . and this new, free 48-page illustrated booklet will show you why.

"Aluminum Substation Structures" shows you many new and interesting facts about the use of aluminum in substations . . . facts that can pay off in big savings for you.

It lists the many ways in which aluminum can meet your substation specifications more efficiently and at less cost. It gives you up-to-date cost comparison data. It offers complete design information including numerous fact-filled tables and schematic drawings.

Here are examples of the type of information you will find in this handy new booklet:

ADVANTAGES OF ALUMINUM. Shows advantages such as reduced maintenance, lower erection costs, greater safety, reduced weight, improved appearance, etc.

MAINTENANCE COSTS. Comparative corrosion resistance of steel and aluminum used in marine and industrial atmospheres. Explains how aluminum saves you hundreds of dollars in maintenance costs.

COST ANALYSIS. Complete data, including quick reference graphs, showing cost comparisons of aluminum and steel for substation structures. This material was recently gathered from utilities, fabricators and electrical equipment manufacturers throughout the country.

DESIGNING ALUMINUM SUBSTATIONS. 28 pages full of design information, including safety factors, fastener clearance, deflection, ice and wind loadings and line loads.

RECOMMENDED ALLOYS. Tells you what alloys to use for substation structurals and fasteners. Gives a complete chemical composition of the most suitable alloys.

DESIGN TABLES. Easy-to-read tables with design data on such subjects as lattice type columns, chord members, maximum compressive stress and force in chord angles, lacing load with bolt shear as criteria, and many more.

You're sure to find helpful information in every section of this new booklet. To get your free copy of Kaiser Aluminum's *"Aluminum Substation Structures"* simply mail the coupon now.

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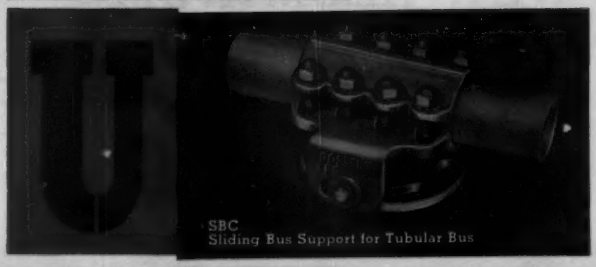
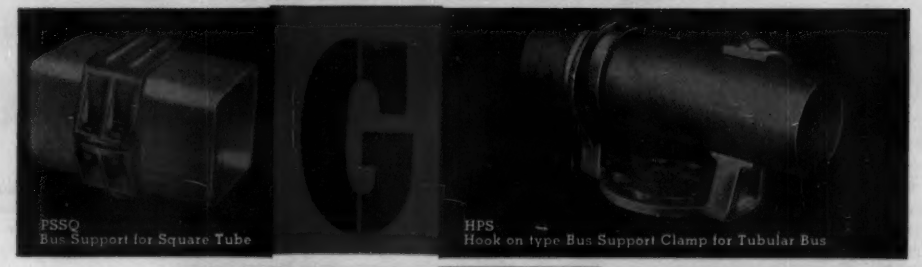
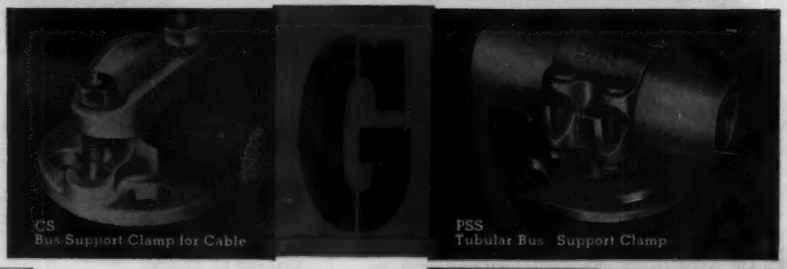
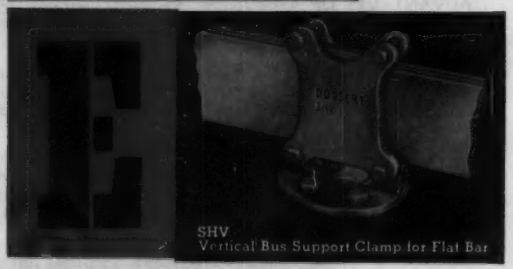






DOSSERT HIGH-STRENGTH BUS SUPPORTS



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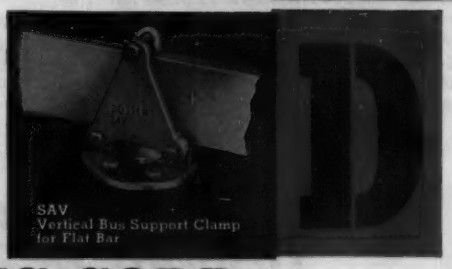
These Dossert Bus Supports are made of a high tensile strength cast bronze alloy and are equipped with silicon bronze bolts and nuts, making the entire unit completely non-magnetic. Available for all sizes and types of busses. Dossert Bus Supports can also be furnished in Coupling, Tee Connecting, Elbow Connecting, Tee Coupling and Expansion Connection types.



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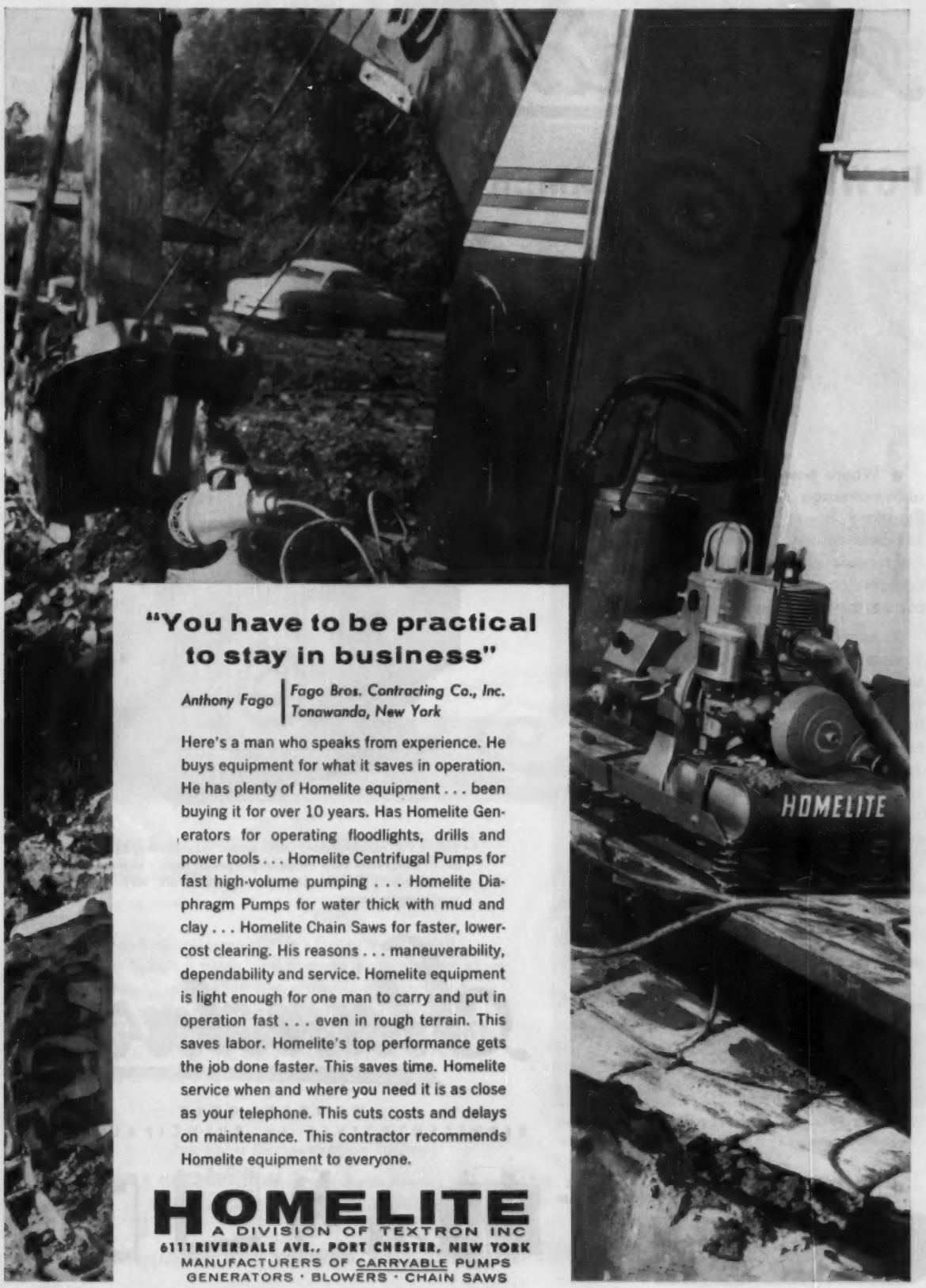

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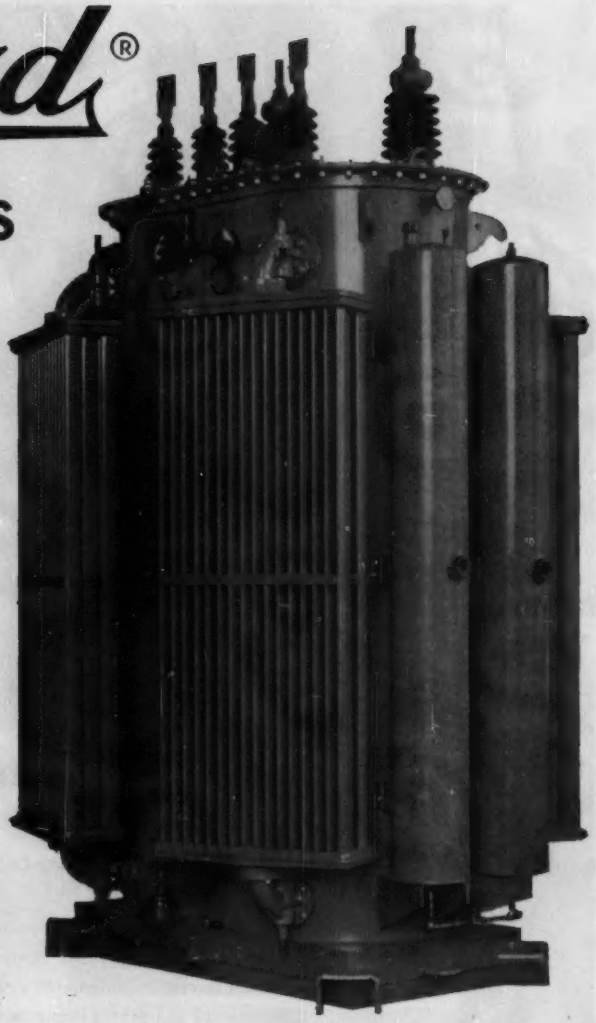

2500 KVA, single-phase, OISC power transformer, 34,500 volts primary, 2400x4800 volts secondary. Special design to meet customer's specifications. Standard engineers will work with you to meet your requirements.

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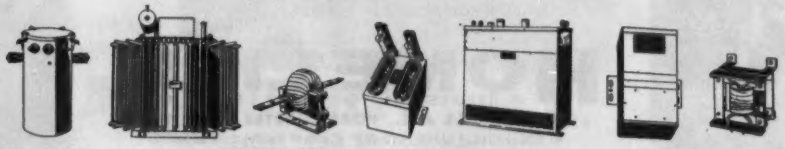

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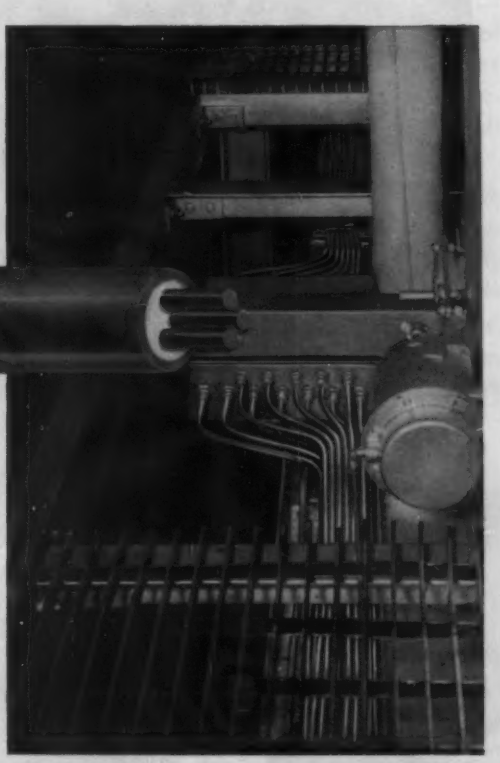
the answer to industrial power wiring...



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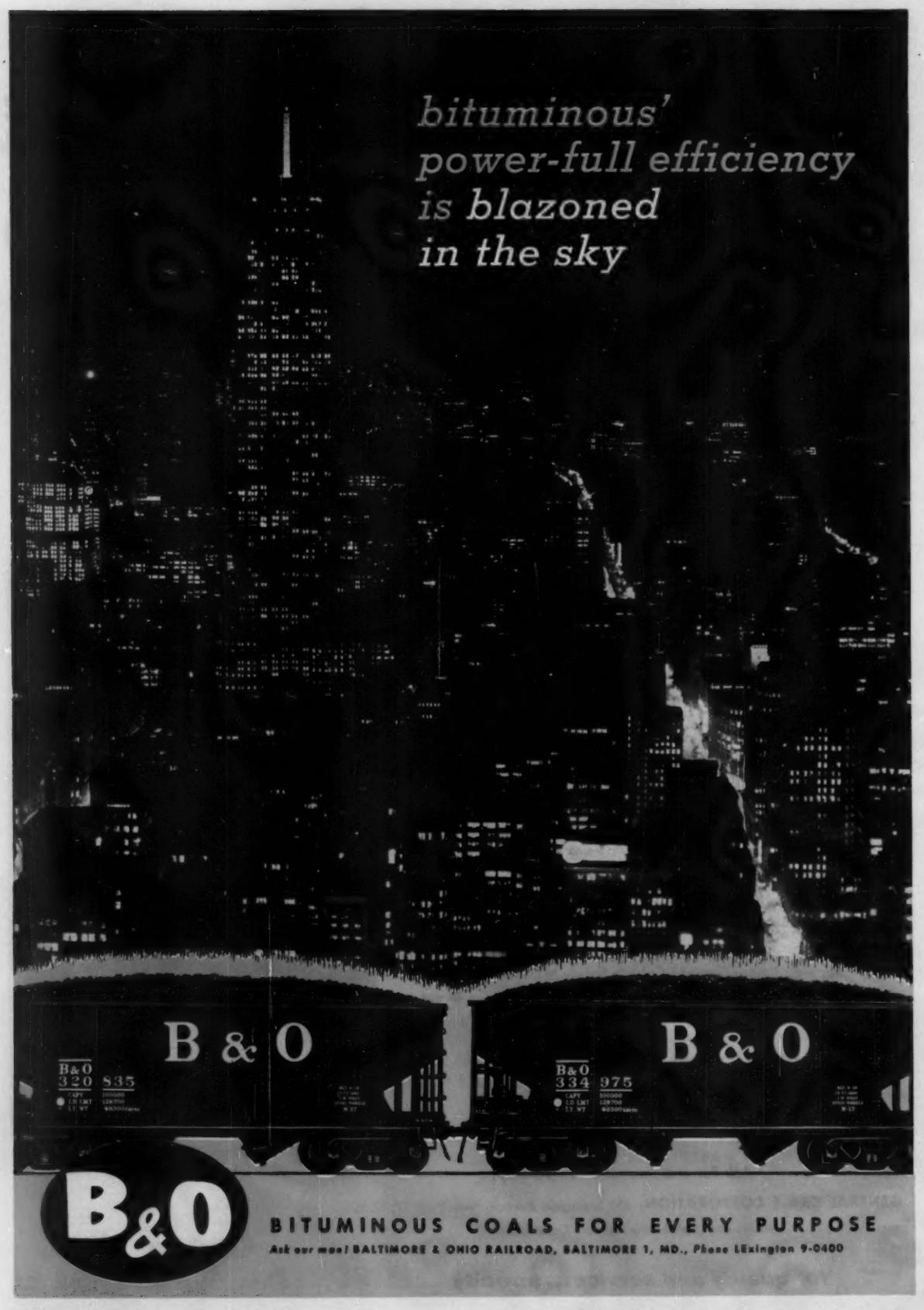
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Paceco first to calculate exact sizes of hydro gate hoists

Paceco tests reduced 540 tons estimate to 390 tons exact requirement

...ASSURING LOWER COST AND GUARANTEED PERFORMANCE!

Now, for the first time in engineering history, Paceco has developed a formula to determine the exact downward pressure on water control gates...the exact power required from gate hoists.

Pacific Coast Engineering Company has completed a research project in cooperation with the Hydraulic Research Laboratories, Division of Industrial Research, State College of Washington, to determine variables in size and design of gates and hoists for water control; to develop formulae to determine accurate, safe performance. Objectives accomplished!

This research project was conducted in connection with the Paceco contract with Merritt-Chapman and Scott Corporation to furnish a 540-ton capacity crane to simultaneously handle three emergency intake gates at the Priest Rapids Project on the Columbia River. As a result of Paceco's tests, the original estimate of 540-ton capacity requirement has been discarded. 390-ton capacity will serve better, with lower first cost—guaranteed performance!

Downstream view of gate well section showing gate and gate hydraulic control system.

Test apparatus showing air bubble flow pattern for typical gate lip.

Pacific Coast Engineering Company invites your inquiries on cranes, hoists, gates and other similar types of major mechanical equipment. May we put to work for you Paceco's research, designing and fabricating skills? Write for brochure C.

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"TAILORS OF STEEL" ®

3 reasons why

UPTEGRAFF

1. Reliability

They know Uptegraff transformers are top quality . . . fully guaranteed . . . meet ASA, NEMA and AIEE standards . . . have a proven record of superior performance . . . have been designed and manufactured by Uptegraff for over 30 years.

Up to 10,000 KVA—all top quality.

Uptegraff Power Transformers are made for either power transmission and distribution or for industrial power utilization.

Load center-liquid and dry type.

Designed for location at center of load. Liquid filled—oil or askarel. Dry type —Class B or Class H insulation.

Before specifying electrical equipment for new or expansion of existing systems, see this helpful engineering data, described in the coupon.

Large stock of dry type lighting transformers.

For serving almost any lighting application. Available from stock in sizes ranging up to 150 KVA.

many companies select

TRANSFORMERS

2. Versatility

They know that Uptegraff transformers are available in a wide range of sizes and types . . . and that Uptegraff has engineering and manufacturing facilities to provide special types for exact customer requirements.

3. Dependable Delivery

They have found that Uptegraff service is prompt and efficient . . . unnecessary delay is eliminated . . . the people of Uptegraff are vitally and personally interested in serving their needs.

That's why more and more companies are standardizing on Uptegraff transformers. They like the top-quality performance, long life and low over-all cost . . . as well as the personal and efficient service.

R. E. UPTEGRAFF MANUFACTURING CO.
Scottdale, Pennsylvania

Overhead and station-type distribution.
Made in various sizes from 3 to 500 KVA and for a wide range of applications. Conforms to latest EEI and NEMA proposed standards.

Mail Coupon Today!

FOR FREE ENGINEERING DATA

Attach coupon to company letterhead. Our Engineers welcome inquiries on any of your requirements—standard or special.

R. E. UPTEGRAFF MANUFACTURING CO.
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Scottdale, Pennsylvania

Gentlemen: Please send available literature on

Power Transformers ☐ Load Center Transformers ☐
Lighting Transformers ☐
Station-Type Distribution Transformers ☐
Overhead Distribution Transformers ☐

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

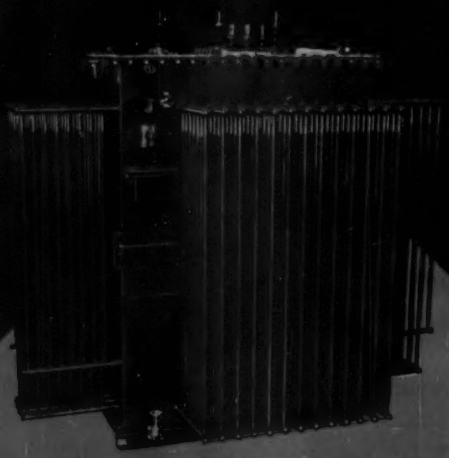
Network transformers.
Conventional and submersible types. Designed and manufactured for standard or special requirements.

3 reasons why

UPTEGRAFF

1. Reliability

They know Uptegraff transformers are top quality . . . fully guaranteed . . . meet ASA, NEMA and AIEE standards . . . have a proven record of superior performance . . . have been designed and manufactured by Uptegraff for over 30 years.



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NAME_____

COMPANY_____

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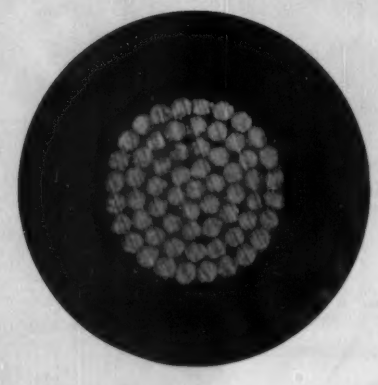
Network transformers.
Conventional and submersible types. Designed and manufactured for standard or special requirements.

The radically new, better way to make 15 KV BUTYL-INSULATED CABLE!

ROEBLING

VCV



NEW VERTICAL CONTINUOUS VULCANIZATION ASSURES CONCENTRIC INSULATION. THE RESULT IS UNIFORMLY HIGH DIELECTRIC STRENGTH AND IMPROVED CORONA LEVEL—THROUGHOUT THE LENGTH OF THE CABLE!

Unlike cable cured by other means, butyl-insulated high-voltage cable produced by Roebling's new Vertical Continuous Vulcanization method is never eccentric, abraided, flattened, scored, and its diameter never varies. Conductor is centered *through every inch of the cable.* What's more, the butyl insulation, even in "thick-wall" cables, is dense, free from internal blisters because every foot is cured at the same temperature and pressure. Controlled concentricity, plus uniform dense insulation, gives these cables their exceptional dielectric strength and corona level.

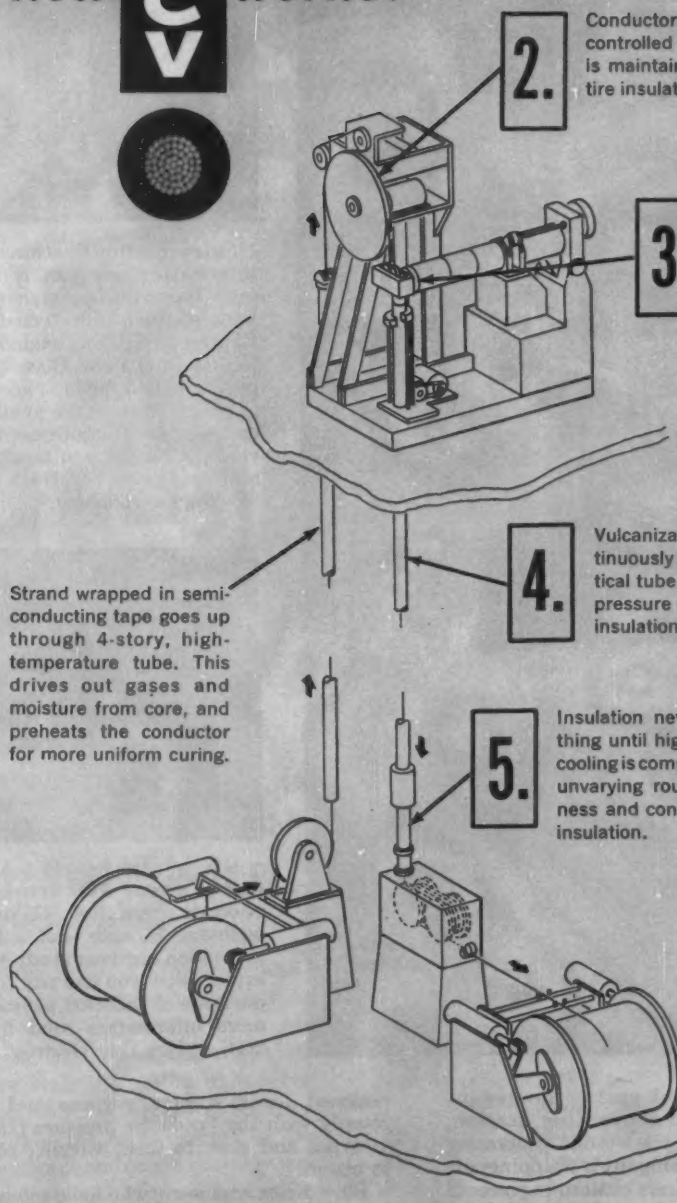
This is superior cable—we don't know how else to say it. For complete information write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING VCV 15KV CABLES are available in a complete range of strand constructions and insulation thicknesses—and with shielding, sheathing and other specifications that exactly meet your requirements.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

Here's how ROEBLING VCV *works!*



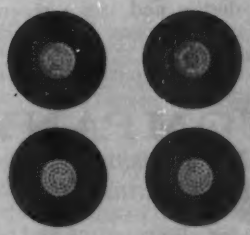
1. Strand wrapped in semi-conducting tape goes up through 4-story, high-temperature tube. This drives out gases and moisture from core, and preheats the conductor for more uniform curing.

2. Conductor is put under controlled tension, which is maintained during entire insulating process.

3. Butyl insulation is extruded downward around conductor.

4. Vulcanization takes place continuously and uniformly in vertical tube. Constant high steam pressure assures dense, sound insulation.

5. Insulation never touches anything until high-pressure water cooling is complete. The result is unvarying roundness, smoothness and concentricity of butyl insulation.



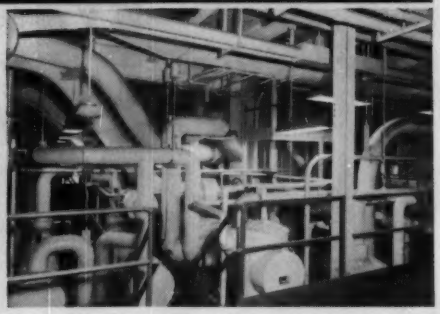
These samples from a single conductor, 500 MCM cable with 42/64 insulation produced by Roebling VCV method were cut (left to right) at 10, 50, 500 and 1000 ft. intervals. Note how all sections have identical diameter and concentricity. Impartial utilities' experts who examined these samples say they've never seen anything to compare with them for uniformity, roundness, concentricity, smoothness and density of insulation.

BLAW-KNOX has what it takes—to provide these products and services

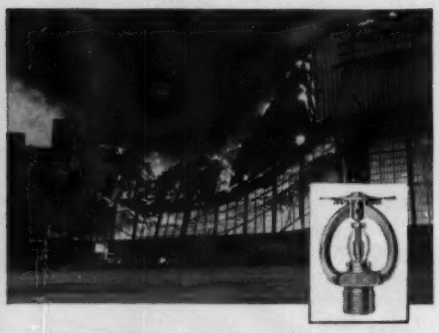
Blaw-Knox trapeze functional spring hanger installed in first large atomic generating station. Vital power piping system for the atomic generating unit in the Duquesne Light Company's Shippingport Station is supported by Blaw-Knox custom-engineered hangers.

Blaw-Knox makes a complete line of standard and custom-engineered pipe hangers, supports, and vibration eliminators. Each is a complete packaged unit, designed for a specific purpose and constructed to comply with the "code for pressure piping." Available in types and sizes to meet varying conditions, ready to install.

Blaw-Knox engineers, who have solved many difficult hanger and piping vibration problems, are always available to both design and make recommendations for your hanger requirements. For further information, write for Catalog No. 54.



Heater piping system in this modern generating station is typical of many high temperature, high pressure systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we'll provide the service you need. For more information, write for Bulletin No. 2443—"Piping for Industry."



Out of every 100 firms who lose their records in a fire, 43 never reopen for business. Be safe. Let a Blaw-Knox fire-protection engineer study your needs—and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

BLAW-KNOX

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures ...complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators ...complete line of automatic sprinkler systems for standard and special hazards

Bushing Insurance

Insulating Sleeve Preserves Life of Compression Spring Assembly ...Adds to Dependability of O-B Bushings

This sleeve is life insurance for your bushings. Here's how it works, and why it's so valuable.

Assembly of the bushing—its strength, its air and moisture seals, its ability to recover from mechanical shock—therefore, its very life, all depend upon the force exerted by the compression springs contained in the oil reservoir. Every make of bushing utilizes some adaptation of this basic spring compression assembly principle.

These springs are tempered steel—an electro-magnetic metal—in a magnetic field. The inherent heating effect is largely offset by nesting the springs external to the conductor, thereby preventing a closed magnetic circuit. But, these springs offer a current path in parallel with the conductor. They can carry a fraction of line current—a duty for which they are poorly adapted, and which can produce heating, accompanied by slow annealment and ultimate loss of proper spring force.

By insulating the bottom of the reservoir from the conductor with a sleeve, current can flow only through the conductor. The springs are not a part of the load current path. There is nothing to cause heating.

This may seem like a small detail. Actually, it is only one of many details O-B has learned in 50 years of successful bushing manufacture —one of the details, when all added-up, that account for the uncommon reliability you've learned to expect, and consistently find, when you specify O-B bushings on your station apparatus.

OHIO BRASS COMPANY
MANSFIELD, OHIO

Ohio Brass

4795-H

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In making appraisals for your company, Ebasco's appraisal engineers augment their broad experience with that of other Ebasco specialists in their particular fields.

For more information, write for our booklet, "Appraisal Services". Address: Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, New York.

Challenging career opportunities are available for qualified engineers. For further information, write to our Personnel Director.

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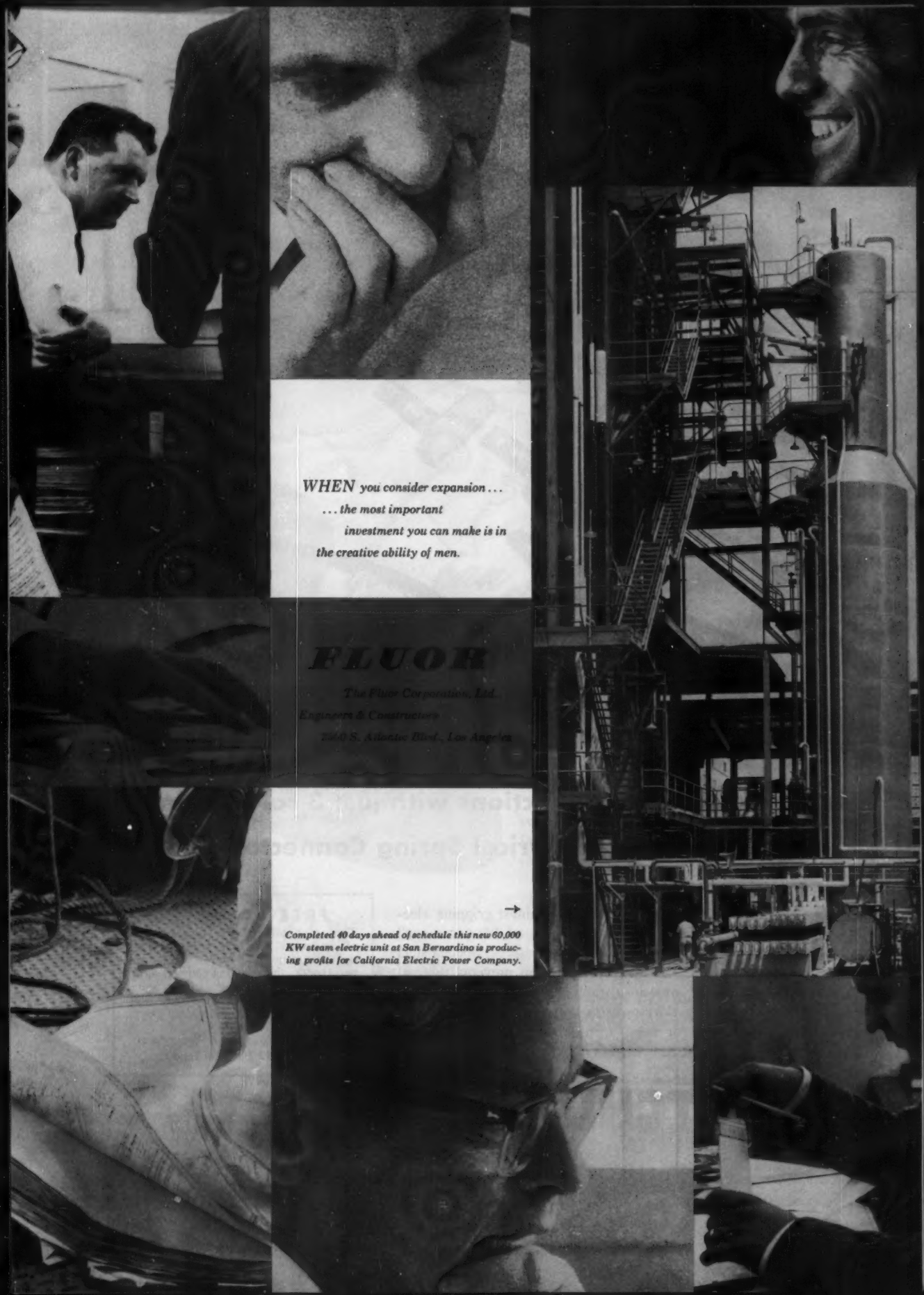

WHEN you consider expansion . . .
. . . the most important
investment you can make is in
the creative ability of men.

FLUOR

The Fluor Corporation, Ltd.
Engineers & Constructors
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Completed 40 days ahead of schedule this new 60,000 KW steam electric unit at San Bernardino is producing profits for California Electric Power Company.

"SCOTCHLOK" Brand Connectors:

Type "Y" for fixtures: No. 12 to 18 AWG solid and stranded.

Type "R", general circuits: No. 10 to 16 AWG, solid and stranded.

Type "B", heavy-duty industrial: 6 to 12 AWG solid and stranded.

Now!

Make all common connections with just 3 color-coded

REG. U.S. PAT. OFF.
SCOTCHLOK Electrical Spring Connectors
BRAND

Strong . . . fast . . . pre-insulated—the tightest gripping electrical wire connectors you can use! Just 3 sizes of "SCOTCHLOKS" handle *all* common connections. And look at the features: Special steel shell prevents cut-through . . . *"live"* spring action prevents thermal loosening . . . unbreakable vinyl insulation doesn't dry out, chip, or crack . . . long conforming skirt protects wires, prevents flash-over. Exclusive triangular shape for easy "turn-on" application. And you know your splice is tight because it *feels* right!

FREE SAMPLES!

Tons of holding power in a fraction of an ounce! See for yourself how tight the grip—50,000 psi! . . . how permanent the holding power! For samples of all three sizes, just write on your letterhead to 3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. BV-1157.

Made by the makers of "SCOTCH" Brand No. 33 Electrical Tape . . .

REG. U.S. PAT. OFF.
SCOTCHLOK Electrical Spring Connectors
BRAND

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PRODUCT OF 3M COMPANY RESEARCH

you can depend on it!

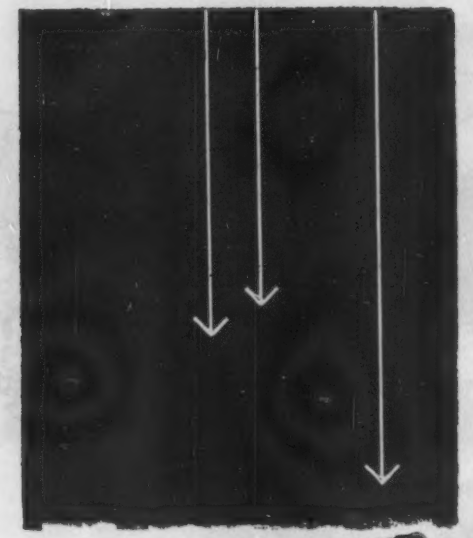
—whenever you specify PORCELAIN PRODUCTS there are two things you can always depend on — SERVICE and QUALITY

Our SERVICE aims and facilities are geared to your anticipated needs—33 Sales Offices, 21 Regional Warehouse Stocks — COAST TO COAST, a strategic network of supply whose sole function is to BETTER SERVE YOU.

The QUALITY of Porcelain Products insulators is recognized by Transmission and Distribution Engineers—and by the men in the field. Their widespread acceptance and ever increasing use justifies the tag of "RECOGNIZED RELIABILITY".

So, for a complete line of Transmission and Distribution Insulators and Fittings, for products that bear the stamp of SERVICE and QUALITY— depend on PORCELAIN PRODUCTS the next time YOU order.

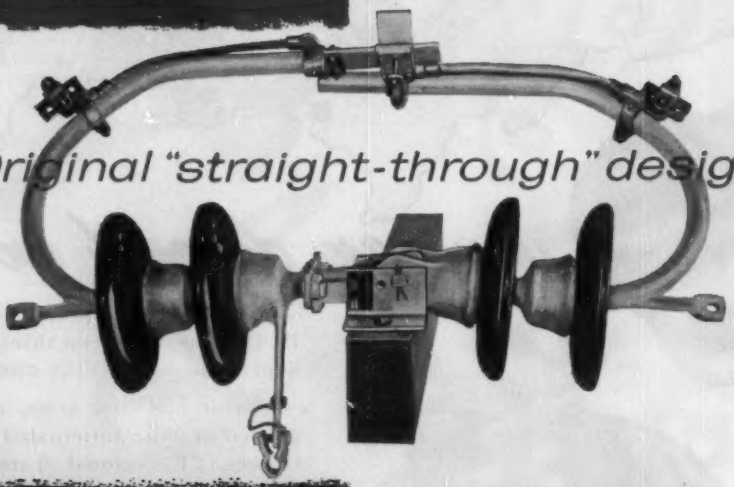
Porcelain Products, Inc.
High Voltage Division **Parkersburg, W. Va.**



Only KPF switches look like this

simple, attractive, trouble-free, proved in 50 years service

Original "straight-through" design



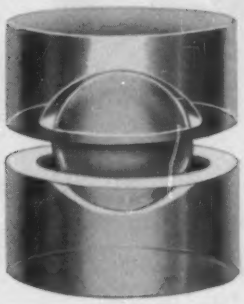
You always know when a power company is using KPF switches. (As more and more are today). You can't miss the clean, functional "straight-through" appearance of KPF phase units. This same design simplicity that produces pleasing pole top appearance also insures all-weather operating ease. KPF switches have no temperamental mechanisms to malfunction, freeze, lock, need lubrication or wear out.

KPF switches have proved their dependability in over 50 years service on major utilities. Make a test installation of the original, "straight-through" air break switch on your system this month.

Write direct for catalog.

KPF ELECTRIC COMPANY
Dept. E. 1624 E. Alpine Avenue
Stockton 5, California

Guaranteed for life!



All Sangamo Watthour Meters—singlephase and polyphase—have lifetime guarantee on materials, workmanship, and bearing system

The ball and jewel bearing system used for years in Sangamo Watthour Meters has been test-proven to withstand 800 million revolutions without appreciable wear. But Sangamo research has now determined that treating the cobenium ball bearing with Molykote® Microsize (the most highly purified molybdenum disulphide) will give such optimum performance that *the bearing system will never need relubrication, inspection or replacement!*

That's why Sangamo now offers an unprecedented lifetime guarantee —covering materials, workmanship, and bearing systems on all Sangamo Meters using the cobenium ball and sapphire jewel bearing system, made after October 1, 1957.

P.S. Ask your Sangamo Representative how you can use this discovery to add to the useful life of your existing meter bearing systems.

JM57-8

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

PREFORMED ARMOR RODS
increase uninterrupted service life of conductor

The wind blows, the conductor vibrates and the life of your line is at stake. If the vibration problem is such that severe frequency and amplitude conditions are sufficiently prolonged, the conductor could begin to break regardless of the protective armor used. And, if the conductor begins to break, PLP Preformed Armor Rods have a big advantage over other armor: The rods undertake the function of an electrical and mechanical repair splice.

All armor rods greatly reduce vibration stresses, but if vibration is severe enough to cause strand breaks, other types will not prevent parting of the strands. With PLP (short pitch) Preformed Armor Rods, it's a different story; the conductor is held tightly and uniformly throughout the entire length of the rods—not at one point. You have a long, firm grip that never relaxes, that maintains conductivity in spite of the break. Thus, your line continues to function unimpaired.

There is one other Preformed advantage to keep in mind. Some types of armor require the use of bolted end-clamps that can shake loose and cause chafing. Preformed Armor Rods require no end-clamps.

For a long uninterrupted service life, Preformed Armor Rods are the best suit of armor your conductor can wear. PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio. Cable Address: Preformed-Cleveland . . . in 10 years the leading manufacturer of armor rods, dead-ends, Guy-Grip dead-ends and other line accessories.

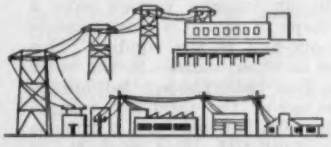
PLP

You can look up to **Preformed**

Made in accordance with or licensed under U. S. Patent Nos. 2,609,653; 2,275,019 and 2,587,521. Other patents pending.

Now | you can simulate | your power system | on your desk top

SOLVE TRANSMISSION AND DISTRIBUTION PROBLEMS WITH THE NEW GENERAL ELECTRIC MINIATURIZED AC NETWORK ANALYZER



THESE DAY-TO-DAY PROBLEMS ARE SOLVED QUICKLY AND ECONOMICALLY:

Load flow studies
Load growth studies
Transmission capabilities
Short circuit and relay studies
System planning—equipment and locations
Incremental loss studies

Relieves engineers for engineering—reduces calculation

The compact, easy-to-operate G-E Miniaturized AC Network Analyzer simulates 4-station power systems on a desk top. This modern electronic computer eliminates so-called "safe" or guesswork calculations. Now, you can arrive at more accurate solutions to your power transmission problems and provide detailed calculations to your system design.

The analyzer operates on 115v and requires no cooling system or special location. A seated operator reads measurements from the slanted panel. Maintenance will be minimized as the component units and circuitry comprising the analyzer can easily be understood by communications maintenance men on your staff.

For more information contact your nearest General Electric Apparatus Sales office. Or write for technical bulletin CPB-4:
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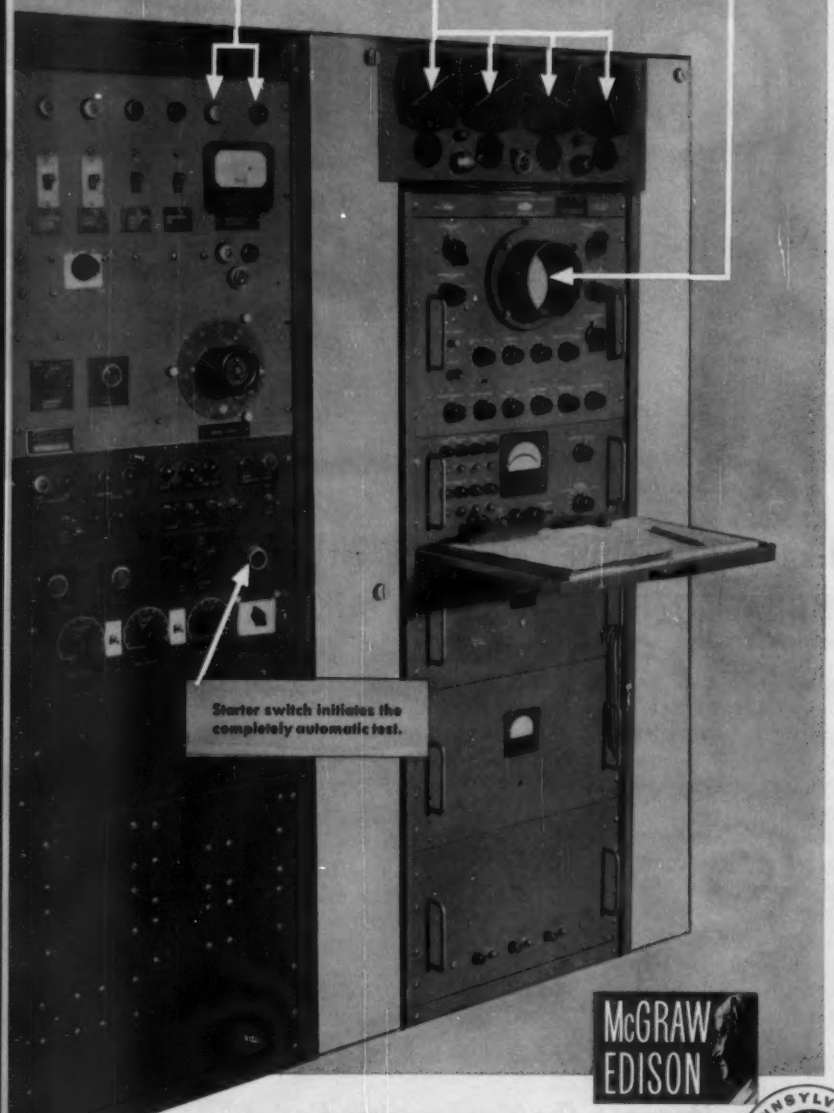
CPA-4 (11-57)

A Report on IMPULSE TESTING of *Pole Star* DISTRIBUTION TRANSFORMERS

Control Center for Pennsylvania's Production-Line Impulse Testing Apparatus


Signals light up and testing automatically stops if a failure—even a single-turn fault—occurs. An alarm bell also sounds.
Large, dial-type indicators provide a check on voltage settings for each test.
Technician in charge observes oscilloscope, which shows the complete impulse voltage wave for every phase of the test cycle.
Starter switch initiates the completely automatic test.

- **What It Is . . .**
- **What It Tests . . .**
- **What It Accomplishes . . .**

WHAT UNITS ARE TESTED

All Pole Star distribution transformers from 3 through 167 kva with high voltage ratings through the 18-kv class are impulse tested. The special apparatus used is an integral part of the production line at Pennsylvania Transformer's Canonsburg plant. Both high voltage and low voltage windings are tested.

NATURE AND MAGNITUDE OF THE IMPULSE VOLTAGE

Test voltages applied to the high voltage windings are 10% above the basic impulse level (BIL) values listed in ASA Standards C57.12. The impulse voltage—which is basically the same as the sudden surge that occurs as the result of lightning—rises to crest value in just 1½ microseconds (millionths of a second) and declines to one-half crest value in 40 microseconds.

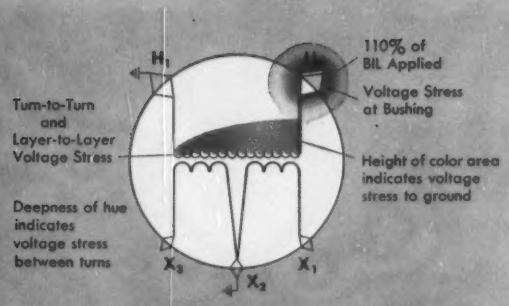
Because of the low impedance of low voltage windings, a wave of shorter duration is used to simulate more closely the surge effects of natural lightning. Low voltage windings thus are tested at a standard voltage value by applying an impulse voltage with a wave shape of ¾ x 1½ microseconds across one-half of the winding. This induces an equal voltage in the other half, so that twice the applied voltage appears across the total low voltage winding. Simultaneously, an impulse voltage of full BIL value is induced in the high voltage winding.

HOW THE TESTS ARE CONDUCTED

So that the transformer itself will be subjected to the full force of the impulse voltage, both conventional and protected Pole Stars are impulse tested *without arresters* or with arresters rendered inoperative. The tests, which are fully automatic, are conducted in the following manner, with the tank

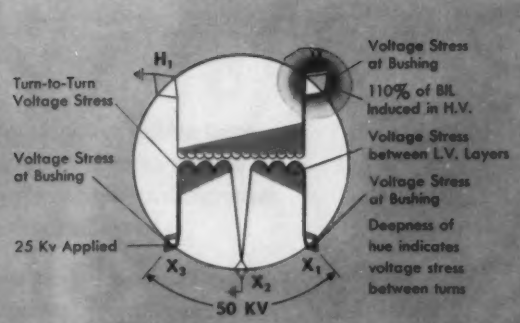
McGRAW EDISON

PENNSYLVANIA (POLE STAR — PENNSYLVANIA TRANSFORMERS) **DISTRIBUTION**



TESTING OF HIGH VOLTAGE WINDINGS

Depicted here is one step in the testing of high voltage windings. In the second step, impulse voltage is applied to H_1 while H_2 is grounded. Test voltages are 10% above the basic impulse levels.



TESTING OF LOW VOLTAGE WINDINGS

Applying impulse voltage in one-half of the low voltage winding induces an equal voltage in the other half. The test also induces an impulse voltage of full BIL value in the high voltage winding.

grounded through a shunt impedance.

For the h.v. winding test, impulse voltage is applied to H_1 while H_2 and X_2 terminals are grounded to the tank. The procedure then is reversed for tests on H_2 while H_1 is grounded.

For the l.v. winding test, impulse voltage is applied to X_1 while H_2 is grounded and a voltage limiting impedance to ground is connected to H_1. The X_2 terminal is grounded and X_3 is ungrounded.

In every phase of the test cycle, the technician in charge observes an oscilloscope that shows the complete impulse voltage wave. Also, an electronic relay is connected so that any failure—even one so minute as a single-turn fault—will automatically stop the testing to indicate the test in which failure occurred.

HOW MUCH OF THE TRANSFORMER IS ACTUALLY TESTED

Traveling at the speed of light, the impulse voltage stresses the turn-to-turn, layer and section-to-section insulation, as well as all insulation to grounded parts, such as the core, core frame and tank. In addition, the impulse voltage fully tests all bushings, leads, tap changers and other accessories. Only transformers that are properly manufactured of highest quality, defect-free material can pass this rigorous test.

WHAT MORE THAN ONE YEAR'S TESTING HAS ACCOMPLISHED

Before production-line impulse testing was initiated at Pennsylvania Transformer, basically the same tests were conducted on Pole Star models and stock units selected at random. This method of testing helped prove the soundness of the Pole Star design, which was further demonstrated throughout the years by Pole Stars' reputation for long-term, trouble-free service.

More than a year-and-a-half of production-line impulse testing, however, has served to make this high quality transformer even *better*. The chief contribution of full-scale impulse testing has been the detection of occasional minor discrepancies—chiefly in component parts but also, from time to time, in certain manufacturing details involving the human element. While these errors are so slight that the units in which they occur have passed *all standard ASA tests* prior to impulse testing, they do represent sources of potential trouble—trouble which may never occur, but which might, in some cases, develop within hours after a transformer is installed.

Of particular significance so far as Pole Star design and construction are concerned is the fact that, during the first full year of testing, actual winding failures occurred in only *one-half of one percent* of the many thousands of transformers tested.

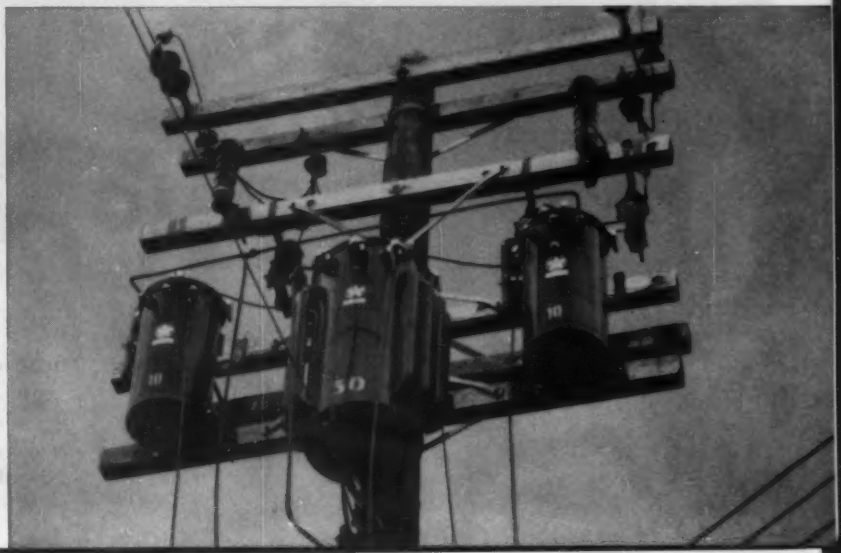
When discovered, *all* causes of failure during impulse testing are attacked with skill and determination by the Pennsylvania engineering and production staffs. Thus far the resulting changes in components (some have been completely redesigned) and improvements in methods have achieved remarkable results. For example, the percentage of rejects for all causes during the last half of the first full year of testing (1.55%) was *over 50% less than for the first six months of the year*. While the rate of percentage reduction may be slower henceforth, production-line impulse testing will continue to safeguard quality, and will be a valuable tool in the hands of production and engineering personnel.

WHAT IT ALL MEANS TO YOU, THE PURCHASER

Even longer average service life than in the past is the principal benefit to be gained by the purchaser of Pole Star distribution transformers as a result of production-line impulse testing. Of course, longer service life means less maintenance, fewer replacements, lower costs—and better service to customers.

Impulse testing provides a highly efficient and constant check on production methods, component parts, and design effectiveness. Call it "quality control" or by any other name—the net result is that the purchaser *always* gets the outstanding quality and efficiency that are inherent in the Pole Star design. There can be no doubt, too, that the knowledge and experience gained from impulse testing will light the way to an even finer Pole Star of the future.

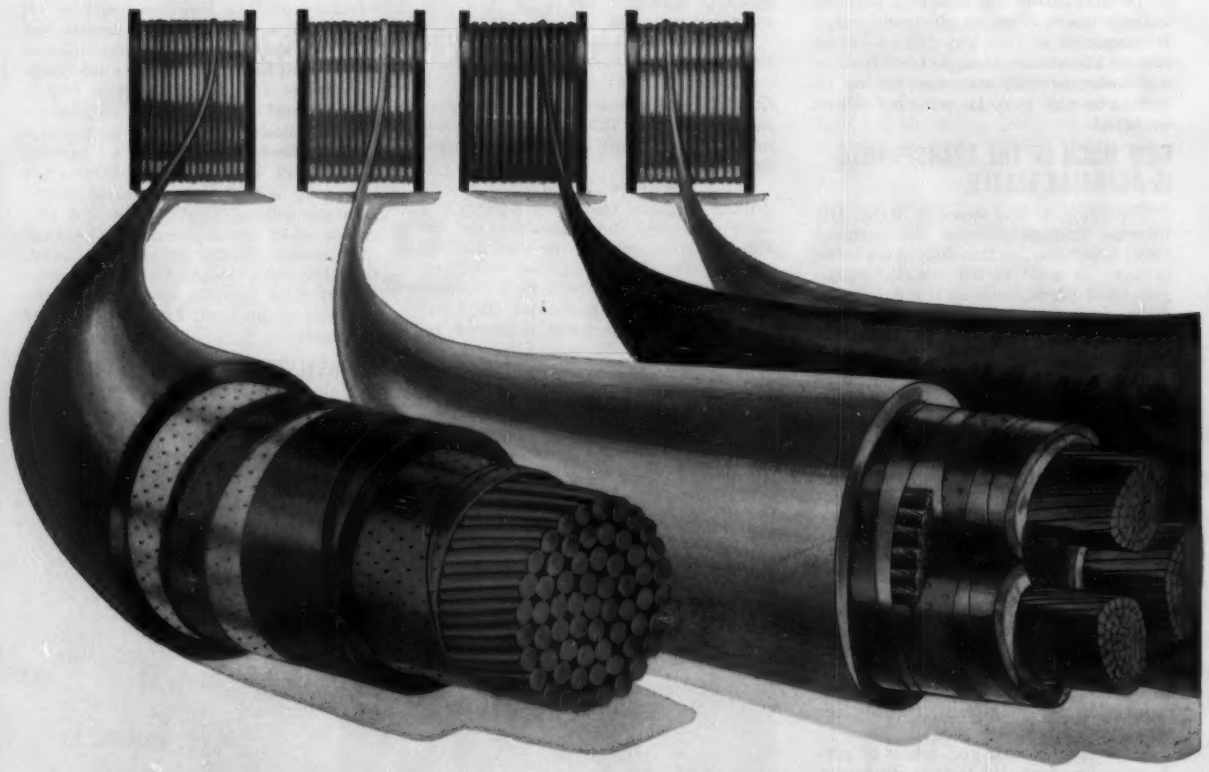
PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY
Canonsburg, Pa.



TRANSFORMERS

FOR THE MOST EFFICIENT
POWER DISTRIBUTION . . . SPECIFY

PAPER-INSULATED CABLES BY PHELPS



Single conductor, 1 KV and up

Three-conductor, 1 KV and up

DODGE!

Phelps Dodge paper-insulated power cables have a *demonstrated record* of long life in a great variety of designs for all types of applications—underground duct, direct burial, submarine and aerial.

Paper-insulated cables have these important inherent characteristics that improve operating performance and lengthen service life:

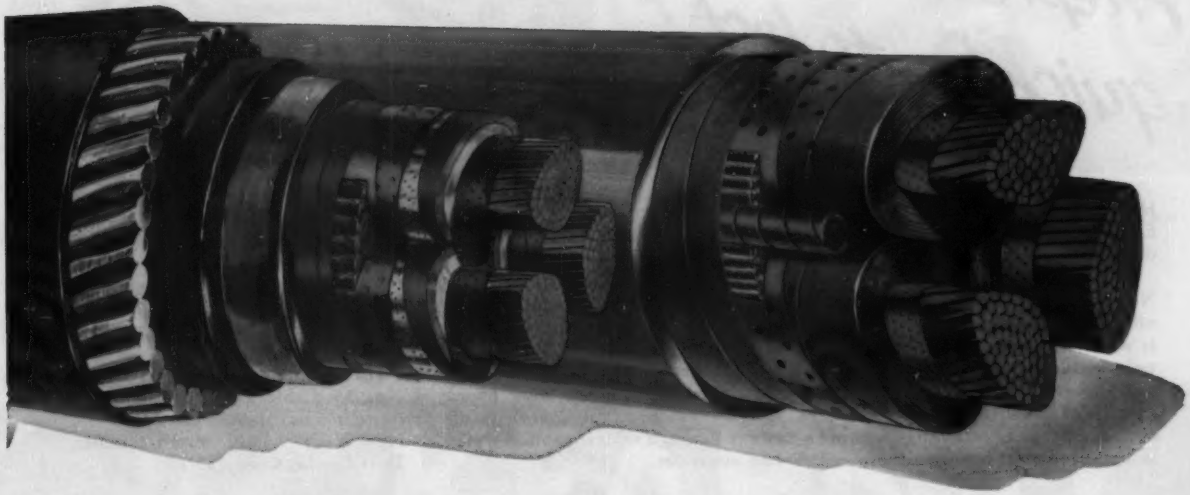
- Extra high 60-cycle and impulse strength to withstand switching and lightning surges.
- Ability to handle large blocks of power in single cables of minimum dimensions.
- Positive protection against all contaminations, due to being hermetically sealed in an extruded metallic sheath.

Paper-insulated cables can be supplied with either lead or aluminum sheaths.

Phelps Dodge offers the widest range of high voltage cables to the electrical industry.

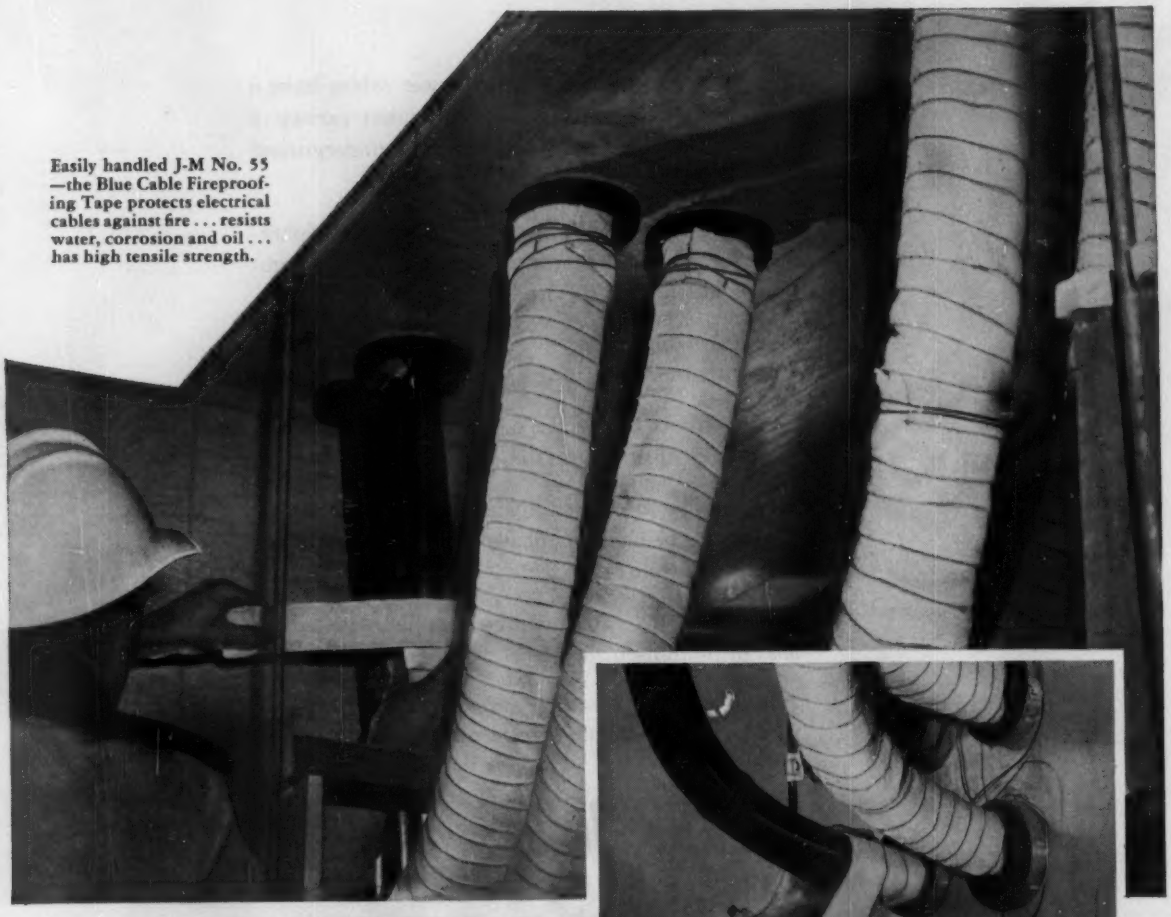
PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, NEW YORK



Submarine, 1 KV and up

Low-Pressure gas-filled, 8 KV and up



Easily handled J-M No. 55 —the Blue Cable Fireproofing Tape protects electrical cables against fire . . . resists water, corrosion and oil . . . has high tensile strength.

Photos courtesy of Lone Star Cement Co., Dallas, Texas

ELECTRICAL CABLES . . .

Fireproofed quickly . . . to last!

with J-M No. 55 Asbestos Cable Fireproofing Tape

Here is the effective, time-saving fireproofing for electrical cables . . . designed for lasting protection.

Made of asbestos, Johns-Manville No. 55 Cable Fireproofing Tape offers many outstanding advantages. It will not support combustion; repels water, resists flame, fungus, mold, corrosion and oil. Explosive or toxic gases will not develop under arc. High tensile strength is maintained even after burnout.

In addition, No. 55—the Blue Cable Fireproofing Tape is impregnated with a silicone material that provides low water absorption and high moisture repellence. Thus, damage from ground water, flooding, fog or humidity is minimized. Selvedged edges prevent threads from pulling out and weakening the tape. There are no ragged, unimpregnated edges through which ground water can penetrate.

J-M No. 55 Cable Fireproofing Tape is simple to apply, even in confined spaces. It won't droop, sag, or unravel . . . assures a tight, lasting wrap. Furnished in widths from 1″ to 3″ in 25- or 100-foot rolls, it is easy to handle and stock.

For complete information on J-M No. 55 Cable Fireproofing Tape, write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville ASBESTOS TEXTILES

JOHNS-MANVILLE JM PRODUCTS

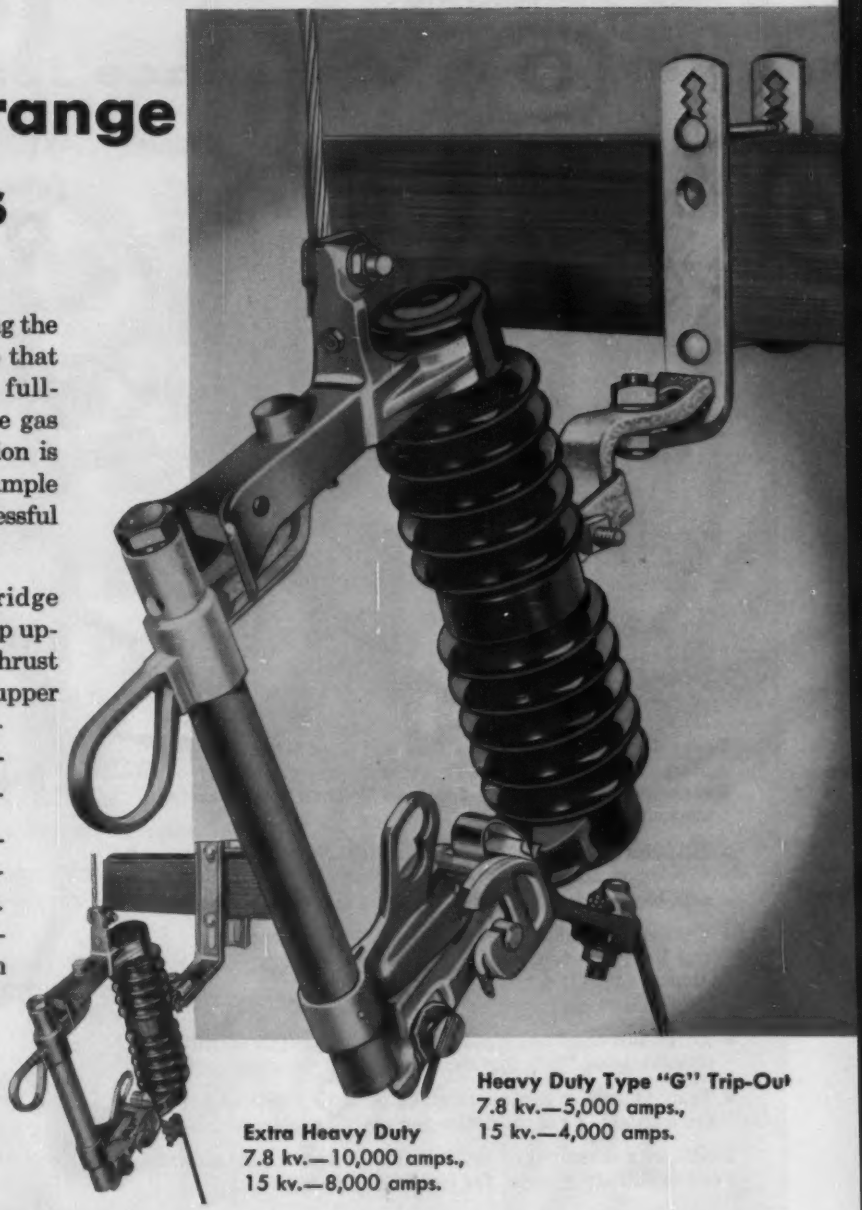
KEARNEY
Type "G" TRIP-OUT Design

assures full-range interruptions

It's the original method of venting the gasses at the top of the cartridge that does it . . . plus the exclusive full-floating upper contact! Adequate gas relief for high current interruption is provided by the top vent—yet ample pressure is developed for successful expulsion on low-fault currents.

During arc interruption, cartridge recoil from top gas jet acts to keep upper contacts closed. Cartridge thrust is absorbed by the full-floating upper contact (patented) which *maintains* contact until arc is extinguished and cartridge drops out.

All cartridges are interchangeable, and marked for quick identification of interrupting rating. Ratings and performance *field-proved* . . . at KEARNEY's own outdoor Substation!



Heavy Duty Type "G" Trip-Out
7.8 kv.—5,000 amps.,
15 kv.—4,000 amps.

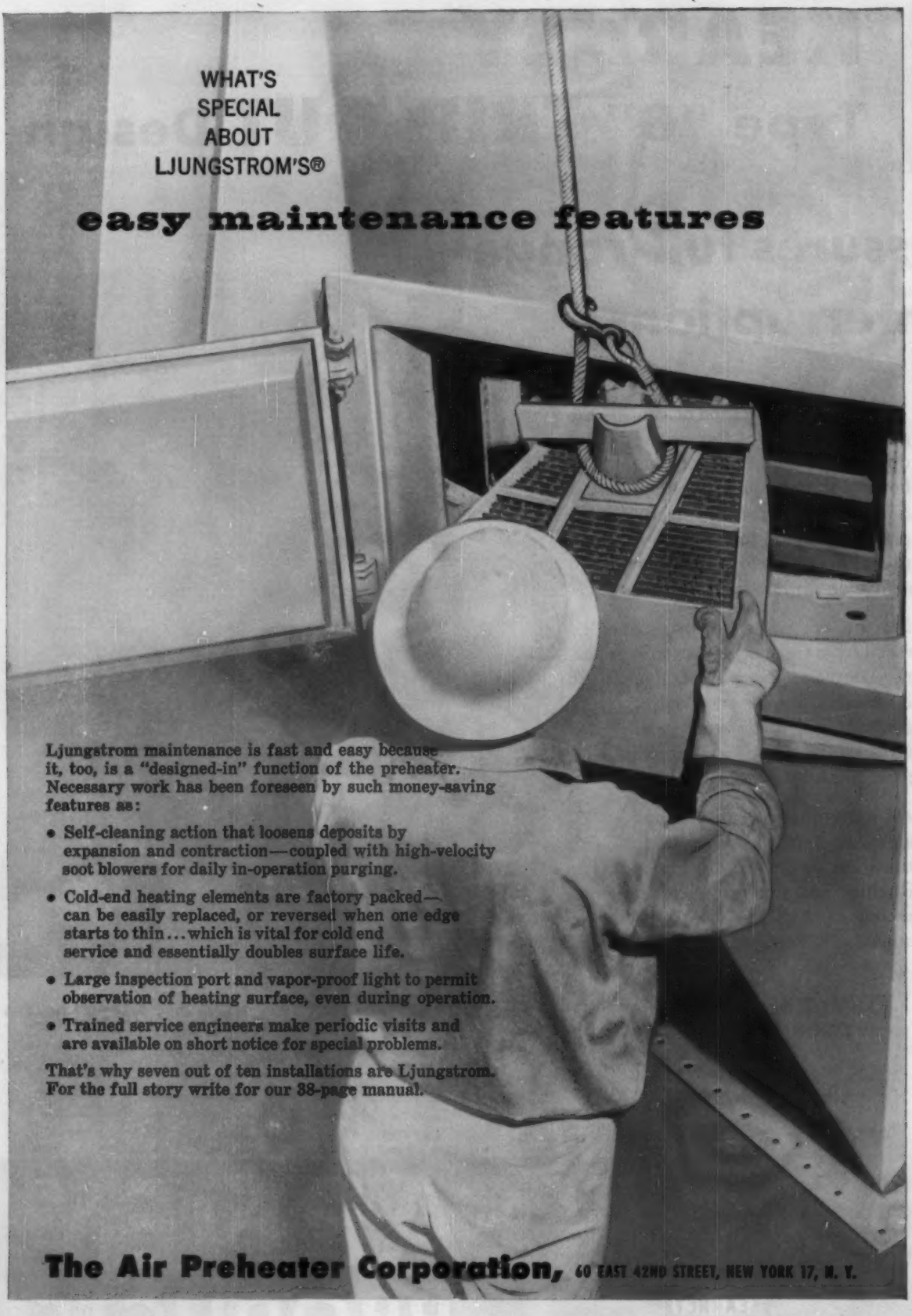
Extra Heavy Duty
7.8 kv.—10,000 amps.,
15 kv.—8,000 amps.

JAMES R. KEARNEY CORPORATION
General Offices:
4236 Clayton Ave.,
ST. LOUIS 10, MO.

349

for BETTER CONSTRUCTION
SAFER MAINTENANCE
Specify KEARNEY
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. GUELPH, ONT.
The Mark of Quality PRODUCTS

Plants at: ST. LOUIS • FAYETTEVILLE, ARK. • SHENANDOAH & CLARINDA, IOWA—GUELPH, ONT., CANADA


WHAT'S
SPECIAL
ABOUT
LJUNGSTROM'S®
easy maintenance features
Ljungstrom maintenance is fast and easy because it, too, is a "designed-in" function of the preheater. Necessary work has been foreseen by such money-saving features as:
• Self-cleaning action that loosens deposits by expansion and contraction—coupled with high-velocity soot blowers for daily in-operation purging.
• Cold-end heating elements are factory packed—can be easily replaced, or reversed when one edge starts to thin... which is vital for cold end service and essentially doubles surface life.
• Large inspection port and vapor-proof light to permit observation of heating surface, even during operation.
• Trained service engineers make periodic visits and are available on short notice for special problems.
That's why seven out of ten installations are Ljungstrom. For the full story write for our 38-page manual.
The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.

Wagner Sealed Dry-Type Transformers can serve under the most adverse conditions

Impervious to DUST, LINT, HUMIDITY, HIGH AMBIENT TEMPERATURES, FLOODING—no need for vaults or barriers

Here's a unit substation transformer that you can safely install in any load center—any place—no matter how tough the operating condition.

Wagner Sealed Dry-Type Transformers are hermetically sealed in a welded steel case to provide positive protection from contamination, fire and explosion hazards.

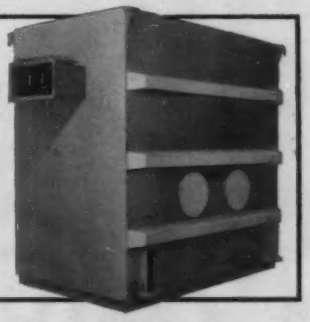
Class H insulation is used throughout the transformer. Core and coils are impregnated with silicone varnish and are sealed in the case which contains inert-dry-nitrogen under pressure to prolong insulation life. Maintenance is reduced to periodic checking of bushings case and gas pressure.

Available in ratings from 300 to 2000 kva, 5 or 15 KV high voltage, 480 volts low voltage. For complete information on these sealed dry-type transformers, write for Bulletin TU-214 or call the Wagner branch office near you.

PREDESIGNED

to save you money

Wagner Nitrogen-Filled Dry-Type Transformers save you individual job engineering time and cost. That's because they are PRE-DESIGNED in standard ratings coordinated with the specifications of unit substation switchgear builders. These standard designs assure quicker delivery of the correct transformer for your load center installation.



Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

T57-11

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

How many generators to

produce 24,000,000 kw ?

About 22,000—so far. That is the number of generators Electro-Motive has built during the past twenty years, for a total generating capacity of more than 24,000,000 kw.

As a leading manufacturer of electrical equipment, Electro-Motive has not only produced thousands of generating units, but in the process, has also contributed materially to "improving the breed." Electrical engineers at Electro-Motive are continuously experimenting with new design improvements, new processes that result in more efficient, longer-lived units.

It is this background of experience in production, design and research that stands behind Electro-Motive power equipment. It is your assurance of dependability, economy and long life under the difficult applications of low load factor generation for which they were designed. Why not ask your Electro-Motive representative for additional information?

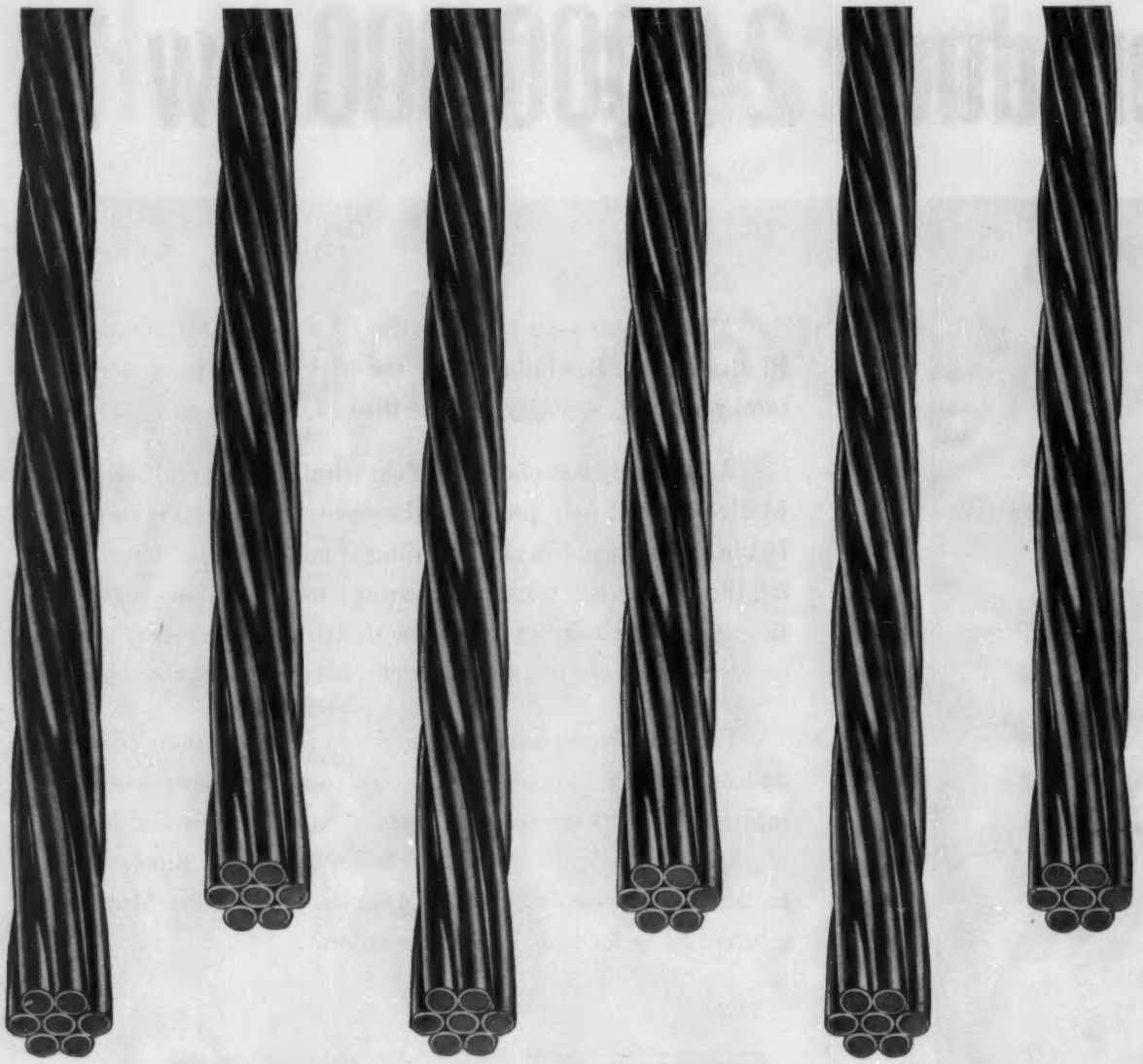
1000 kw units for use on sidings or placed on piers for semi-permanent use.

500 kw units offer excellent mobility for many temporary applications.

LIVE BETTER ELECTRICALLY

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS
LA GRANGE, ILLINOIS

Sales offices in Chicago, New York, St. Louis, San Francisco
In Canada: General Motors Diesel, Limited, London, Ontario



Strand with the coating that protects for years

Whenever strand is installed, it is immediately subject to attack by relentless enemies—rain, snow, ice, smoke- and fume-laden air. The only thing guarding the steel wires of the strand is the coating that surrounds them.

Bethlehem strand is protected from this daily attack by a layer of highly pure zinc—a coating applied by a special method called bethanizing. In essence, bethanizing is an electrolytic process that creates a tighter bond between coating and wire. Equally important is the marked degree of ductility achieved in the coating. Working together, the tight bond and the high ductility all but eliminate peeling and cracking.

The bethanizing process has made it possible to produce the heavier weights of coatings which have proved their importance to the utilities. These heavier weights have become standard where longer life under severe exposure conditions proves their economy.

Bethlehem strand, with the added protection offered by bethanizing, always does a sound, honest job. It is a product that will give the user extra years of service. Call or write our nearest office for full details.

BETHLEHEM STEEL COMPANY
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BETHLEHEM STEEL

BETHLEHEM STEEL

Laboratory high in the Rockies searches the unknown to bring about

Tomorrow's supervoltage transmission lines

High in the Rocky Mountains west of Denver, men are at work on a project that promises valuable benefits to the entire electric utility industry.

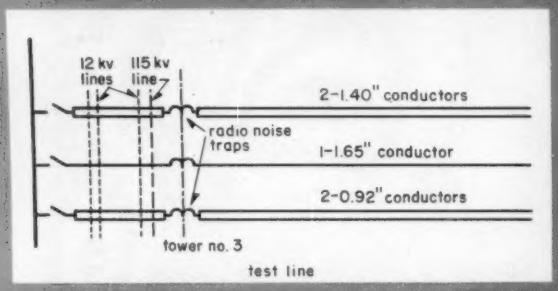
There, Public Service Company of Colorado, in cooperation with Westinghouse and other company manufacturers of high-voltage equipment, has created a giant outdoor laboratory.

Their purpose: to study and measure the elusive phenomena of corona and radio influence, and establish facts upon which the supervoltage transmission lines of tomorrow can be designed.

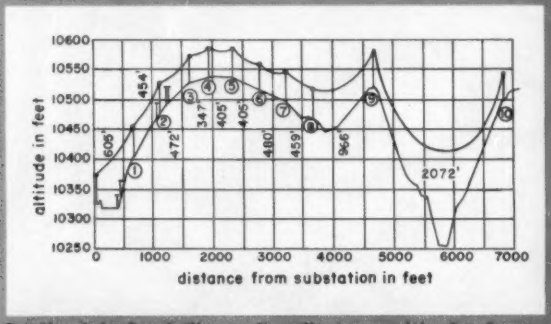
Photo at left shows Harry Morgan, Westinghouse Sales Engineer, discussing some of the equipment under test with L. M. Robertson, Chief Electrical Engineer and sponsor of this project for Public Service Company of Colorado.

YOU CAN BE SURE... IF IT'S

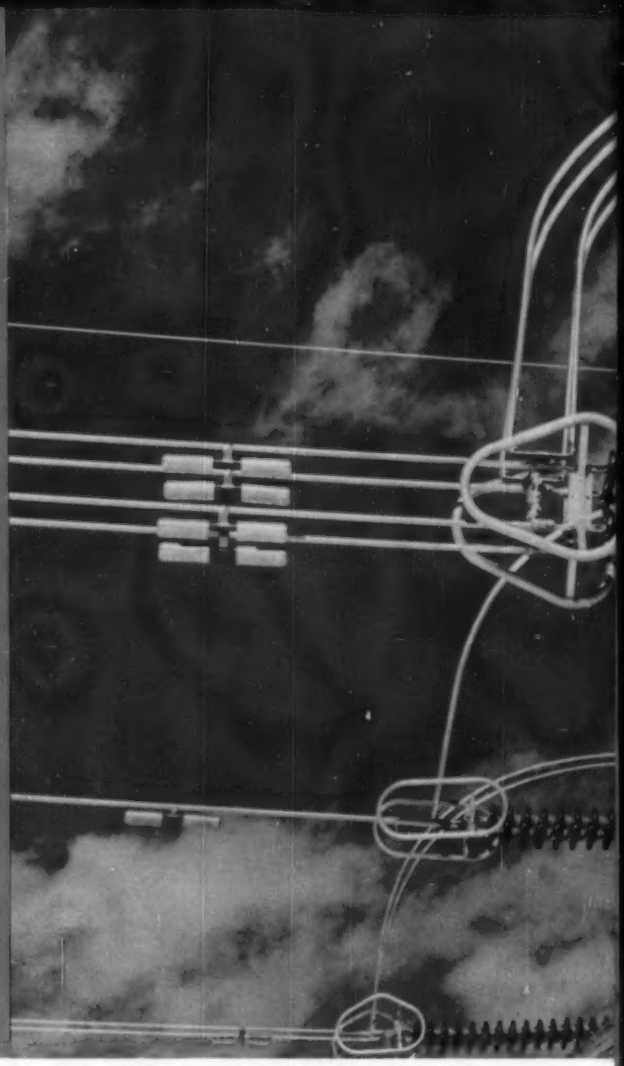
Westinghouse



Schematic diagram of conductors as they will be tested, showing the radio noise traps at Tower No. 3 to isolate the test line from radio influence of nearby transmission lines.



Profile of the Leadville test line illustrates altitude of tests. Note foreshortening of distance from substation.



Close-up of Tower No. 3, high over Leadville. Largest conductor is the single conductor in the middle, a duplicate of Tidd conductors. The four-bundle in the foreground is medium size, later to drop to two-bundle for testing. The two-bundle conductor in the background is the smallest line size under test.

500,000-volt corona tests are now underway in the Colorado Rockies

Extra-high voltages will be required for economical transmission of the electrical industry's rapidly mounting energy requirements. Westinghouse is now prepared to supply much of the equipment required to handle these voltages. But the entire industry is aware that additional information is still needed regarding corona and the resulting energy losses, as well as the radio influence it creates at high altitudes.

The AG&E tests at Tidd Station made great strides. Additional performance data gained at Leadville, it is hoped, will make ehv practical not only system-wide, but nationwide.

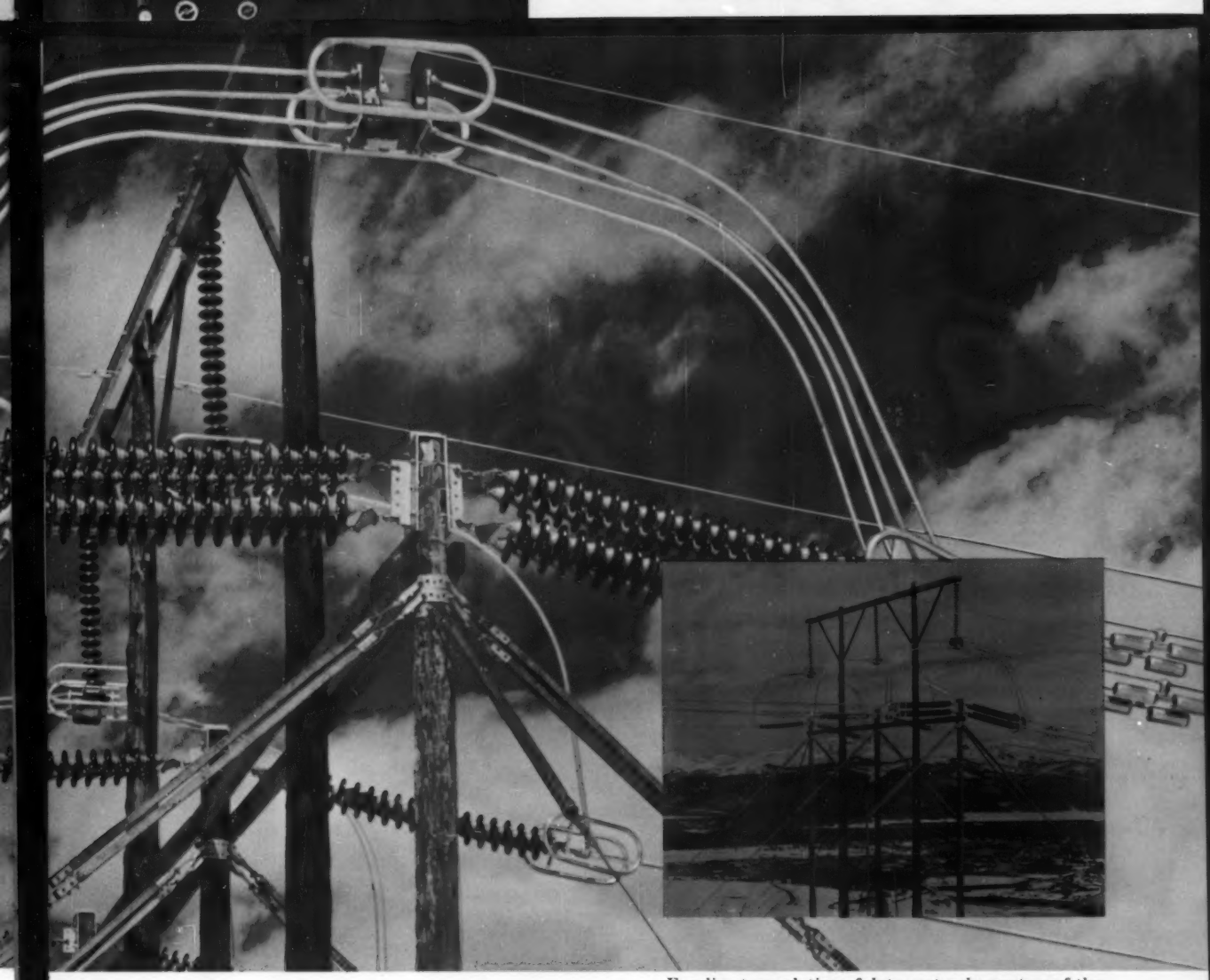
With line construction and instrument calibration now completed, Public Service Company and its collaborators are embarking on the actual tests, ranging upward from 173 to 500 kv.

Towers carry three single-phase circuits, data later to be correlated to three-phase. Circuit No. 1 bundles four 1.40″ conductors. No. 2 carries one 1.65″, and No. 3 bundles two 0.92″. All conductors except the latter are expanded ACSR.

The four-bundle circuit, having adequate conductor for zero corona at the voltages under test, served to develop reliable data for instrument calibration. On completion of calibration, this circuit will drop one line to run brief tests as a three-bundle and, finally, will drop one-third to get comparative data with two conductors.

Energy loss and radio influence will be measured under violent extremes of weather

The test site at Leadville was selected because the altitude averages 10,500′, with temperatures ranging from high 80's to 30° below. Test lines are sub-



For direct correlation of data, not only are two of the conductors designed to duplicate Tidd tests, but the Westinghouse transformer, arresters, disconnects and measuring equipment were shipped directly from Tidd to Leadville, Colorado.

ject to wind velocities, rain, snow and atmospheric conditions that would be difficult to simulate for components in a laboratory; impossible to recreate for an entire transmission line. Existing data concerning the effect of altitude (low barometric pressure) on corona are based on work with relatively small conductors in evacuated chambers.

Two-mile high Leadville tests will extend knowledge gained in Ohio Valley Tidd Project

No. 2 and No. 3 circuits at Leadville, carrying one 1.65″ conductor and two bundles of 0.92″ conductors, are designed for direct correlation with data gathered on these conductor sizes at Tidd Station. The Westinghouse substation equipment transformer, arresters and disconnects were originally furnished for the Tidd tests. At the conclusion of the Leadville test, this same equipment will be used in the AEIC high-voltage cable test program.

YOU CAN BE SURE... IF IT'S

Westinghouse

Westinghouse

cooperates with Public Service Company of Colorado to move back transmission frontiers

Westinghouse is proud to be a member of the participating manufacturers collaborating with Public Service of Colorado. Some of the Westinghouse equipment furnished is shown here. But more important is the knowledge to be gained . . . basic knowledge for the benefit of the entire industry . . . unequalled experience in ehv equipment to influence designs of the future.

With this telescope located in the station house, Jim O'Neil takes a direct reading on the instruments on top of the transformer as a cross check on the recorder located in the "nerve center."

Harry Morgan of Westinghouse is shown with L. M. Robertson, Chief Electrical Engineer of Public Service, at the upper level of the substation. Note the instrument panel on high-voltage bushing which reports current and voltage at start of line.

LEFT: Nerve center of the "great outdoors laboratory." James O'Neil, Westinghouse Engineer, and Joseph Wissenbach, Communications Engineer for Public Service, are shown checking the charts that record: (1) conductor temperature, (2) air temperature, (3) dew point, (4) barometric pressure, (5) wind direction, (6) wind velocity, (7) line voltage, (8) line current, (9) corona loss in kw, and (10) radio influence.

RIGHT: Another of the double-check points. Jim O'Neil and Joe Wissenbach inspect the radio influence detection equipment located at the base of the main transformer.

LOWER RIGHT: Radio influence meters are located at various distances from line. To protect them against the extremes of weather, without damping their sensitivity, they are enclosed in temperature-controlled all-plastic huts.

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Westinghouse

C. F. WAGNER,
Consulting Engineer
Engineering & Service Dept.
AIEE Fellow, CIGRE

W. E. PAKALA, *Advisory Engineer*
Research Laboratories
Member: AIEE, IRE

D. F. SHANKLE,
Engineer-in-charge
Advanced Development Group
Member: AIEE Committee on Switchgear
AIEE Standards Committee
NEMA Power & Communication Co-ordination Committee

J. K. DILLARD, *Manager*
Electric Utility Engineering
Member: AIEE Committee on Transmission and Distribution
Chairman, AIEE General Systems Subcommittee
Vice-Chairman, AIEE Committee on Power Rectifiers

T. J. BLISS, *Engineer*
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Associate Member: AIEE

H. S. SHOTT, *Consulting & Application Engineer*
Electric Utility Engineering
Member: AIEE

J. E. O'NEIL, *Engineer*
Advanced Development Group
Associate Member: AIEE

B. J. SPARLIN,
Laboratory Engineer
Radio Influence Laboratory
Member: AIEE

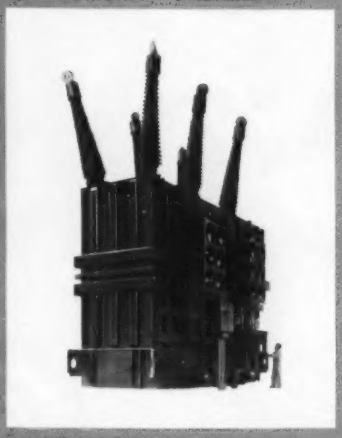
The Extra-High Voltage tests

...another example of the Westinghouse "Plow-Back" policy

It has been a consistent policy of Westinghouse for years, to invest time, talent and money in the development of new knowledge as well as new equipment for the industry. While tests continue in the High Voltage Laboratory in East Pittsburgh and in divisional laboratories throughout the company, proving out new equipment, research teams working with the nation's electric utilities explore the industry's unknowns.

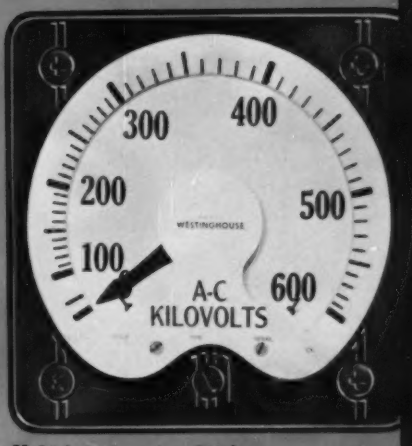
The Westinghouse engineers co-operating on the Public Service of Colorado tests are shown above.

YOU CAN BE SURE...IF IT'S Westinghouse

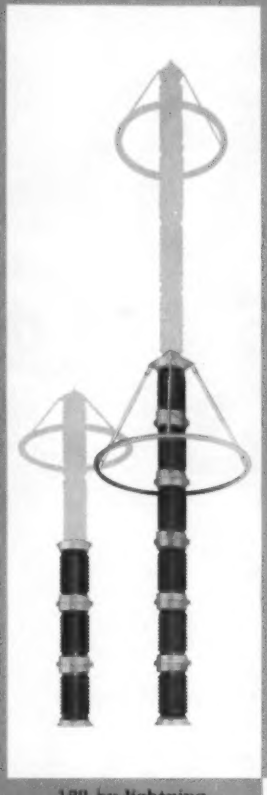


400,000-kva autotransformer

25,000,000-kva power breaker

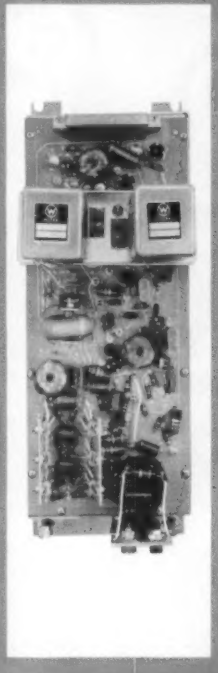


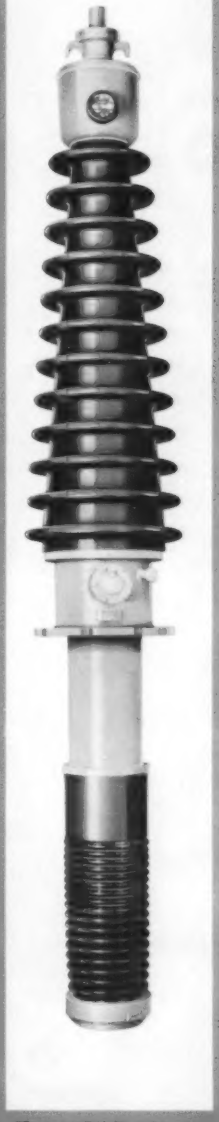
K-24 instruments—600 kv



182-kv lightning arrester

Completely transistorized carrier

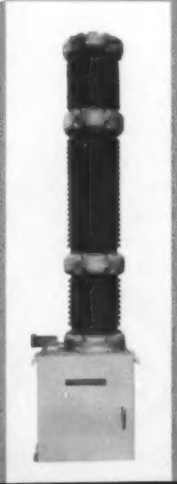




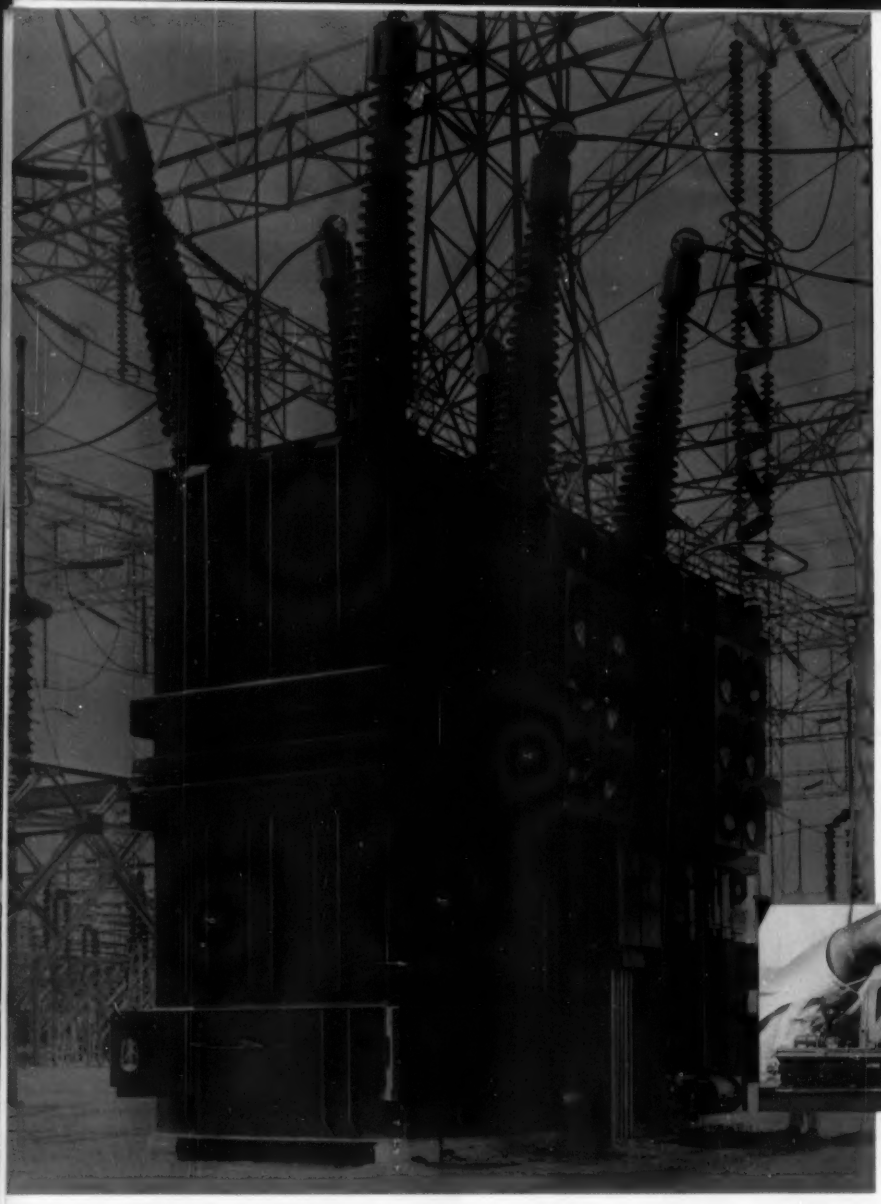
Type "O" Bushing—92-345 kv

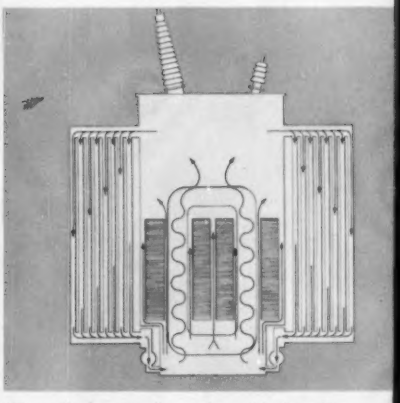
The Westinghouse "Plow-Back" policy has already resulted in equipment now ready for supervoltage transmission

K-Dar compensated relay system



196-kv high-speed grounding switch





Close-fitting tank and vertical coil construction of Form-Fit transformers combine to form directed paths for coolant. Forced-oil cooling eliminates need for thermal head, provides maximum coverage of coil surfaces within minimum space.

Shell-form construction places core on the outside, coils inside for maximum mechanical strength. Solid insulation is used at high stress points; creepage surfaces eliminated.

New Westinghouse-designed transformer railroad car will permit more direct routing . . . faster delivery to help speed your construction schedules. With the transformer suspended only six inches above rails, and with a capacity of 250 tons, this car, the "Schnabel," provides additional room to grow . . . will permit transformers of the supervoltage era to be shipped in one piece.

From design to delivery...

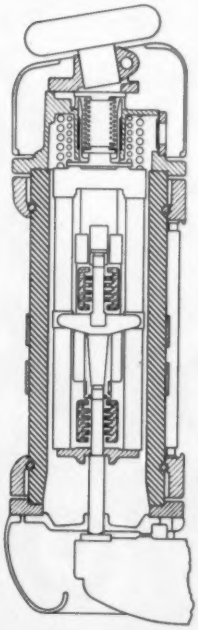
Transformers with room to grow meet the challenge of ehv* future

Extra-high voltage transmission of the future presents no problems for Westinghouse transformers. Utilizing the basic "Form-Fit"® design with forced-oil cooling, these transformers are both smaller and lighter per kva than any other design. Here is a design with room to grow . . . a principle that can be extended to any foreseeable voltage level . . . meeting the challenge of the supervoltage future.

Westinghouse can now build transformers with voltages practical for the next decade . . . voltages up to 380, 440, 500 kv or beyond.

*extra-high voltage

Westinghouse high-power laboratory made possible world's first 345-kv breaker, paved way for ehv



Developed in the Westinghouse high-power research laboratory, the tubular, multi-break interrupter made possible the world's first 330-kv, 25-million-kva circuit breaker. This development has made practical the extension of circuit breaker ratings into still higher voltages; it will pave the way for solution of problems involved in handling extra-high voltages . . . supervoltages of 500,000 and above.

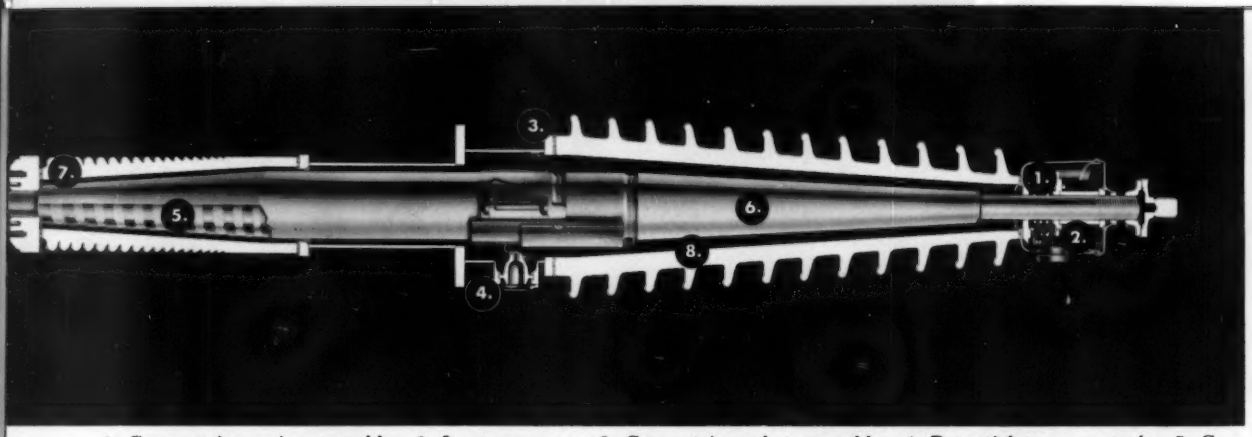
ultra-high-speed reclosing can be extended to ehv breakers

Trouble-free, trip-free service is provided by pneumatic operating mechanisms in Westinghouse circuit breakers rated to 345 kv. Both mechanically and electrically trip-free, breakers trip open in standard operating time when closed on a fault. Reclosing is fast—just 15 or 20 cycles. Automatic selection of trip-free or non-trip-free operating results in ultra-high-speed reclosing for larger breakers.

These are some of the benefits you can expect to find extended into the supervoltage future.

Now in use in breakers up to 345 kv, the tubular interrupter grids also have excellent line-dropping and capacitor-switching characteristics—proved in laboratory and field tests. *Additional tests have proved the performance of this interrupter at even higher voltages.*

YOU CAN BE **SURE**... IF IT'S **Westinghouse**



1. Compression spring assembly 2. Inert gas space 3. Concentric gasket assembly 4. Potential tap receptacle 5. Concentric foil layers 6. Oil-impregnated condenser 7. Porcelain arc shield 8. Porcelain weather casing

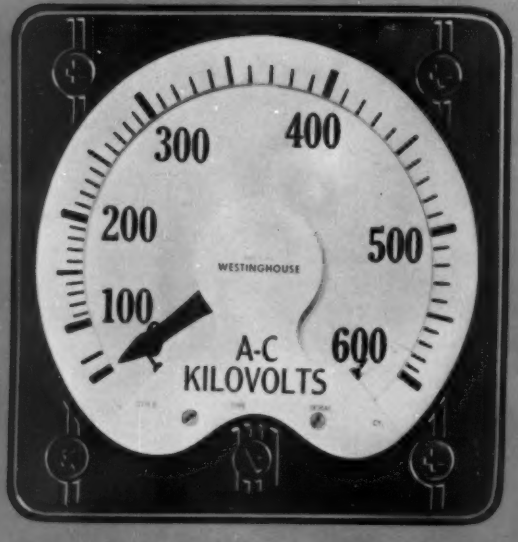
Fifty years' bushing dependability builds toward corona-free ehv

As demands on power equipment go up and up, so —ordinarily—do the problems of corona. But the Westinghouse Type "O" bushing used for breakers and transformers in the higher voltage range—92-345 kv—is far from ordinary.

The Type "O" bushing is corona-free. It has greater dielectric strength than any other bushing made; vacuum oil-impregnation of the condenser insures insulation with the highest possible strength in a minimum of space.

Westinghouse pioneered the condenser principle, has designed, built and improved condenser bushings for 50 years, building toward the era of supervoltages, building toward corona-free ehv bushings.

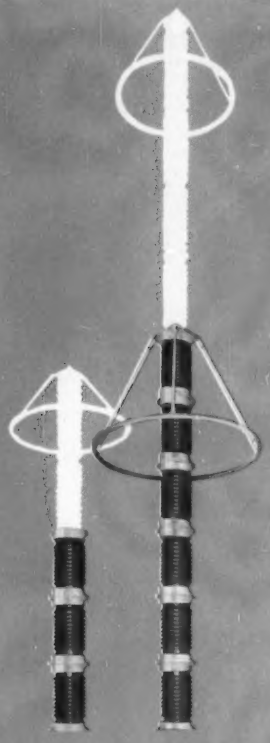
Seeing is believing with super-legible K-24 instruments



Important electrical data is gathered by accurate instrumentation . . . and costly errors must be avoided. Westinghouse K-24 circular-scale instruments—designed to help eliminate these errors—can be read at distances of 20 feet or more, at angles up to 65 degrees. Shadow-proof and glare-proof, the dials of K-24 instruments keep distortion of readings at a minimum.

The long scale, coupled with small flange area, increases readability and saves space—K-24 instruments can be grouped compactly in higher banks, do not have to be spread out at a lower level. K-24 instruments simplify one-man operation.

Accuracy for the future. This K-24 instrument dial for extra-high voltage applications provides a good demonstration of how great even the smallest error can be. Each division on the dial represents 10 kv. Excellent legibility practically eliminates chances of misreading dial.



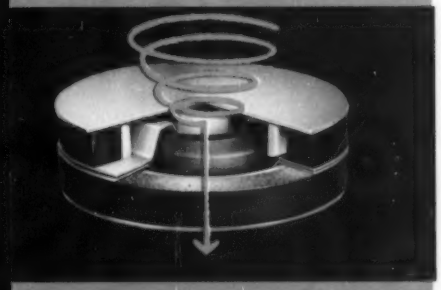
The new reduced-height type SVS arresters are self-supporting; installation is simpler—up to 300,000 pound-inch cantilever strength.

Westinghouse shrinks arresters, tailors height and performance to tomorrow's supervoltages

The constant increase in the physical size of lightning arresters resulting from ever-rising voltages could have caused a critical space problem. But Westinghouse engineering came to the rescue . . . developed an arrester design that not only reduced the height of arresters for present high-voltage ratings, but provided room to grow for the supervoltage requirements of the future. The height reduction—up to 45 percent—from this new design stems from physically paralleled elements, connected in series electrically.

At the same time, greatly increased operation due to switching surges called for a means of preventing pitting and other damage to the gap electrodes. This was achieved with development of the new Mobilarc gap, utilizing a radially polarized magnet which spins the arc around a longer path on the gap electrode surfaces. Due to the movement of the arc, the electrodes are not affected . . . maintain their original condition. Currents of 100,000 amperes have been discharged through the gaps without changing the permanent magnetic field.

These two developments have resulted in better performance packed into a smaller arrester . . . another example of Westinghouse designing for the supervoltage future.



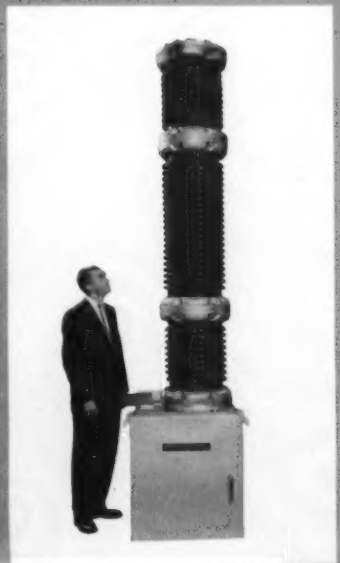
The Mobilarc gap safely spins the arc over the electrode, with no change in gap characteristics—even after 1,300 tests.

Faster, better protection for your transformers of the future

The new Westinghouse high-speed grounding switch closes in five cycles—six times the speed of conventional grounding switches. This revolutionary unit initiates a ground fault which trips remotely located circuit breakers, clearing the line before extensive transformer damage can occur. Closing time is minimized by locating the contacts relatively close together in a high-dielectric sulphur-hexafluoride (SF-6) gas atmosphere, and by providing reciprocal blade action instead of swinging action.

Contacts and mechanism are fully enclosed—impervious to weather. Speed and reliability are maintained even under conditions of severe icing and with temperatures as low as —40°F.

The grounding switch in ratings up to 196 kv is protecting today's transformers from damage. With the design principle of this switch, ratings can readily be increased as needed to afford this same protection to tomorrow's supervoltage equipment.



This 196-kv grounding switch is one of two built by Westinghouse for Pennsylvania Power & Light Company's Peckville substation. This unit is capable of closing a 20,000-ampere circuit in five cycles.

YOU CAN BE SURE...IF IT'S Westinghouse

Extra-High Voltage transmission puts new emphasis on reliable carrier communication

Accurate decisions in a utility have always depended upon quick, accurate transfer of information from remote locations to a central control point. With the increasingly high equipment investments in transmitting high voltages, the advantages of the Westinghouse power line carrier become even more important . . . whether the unit is for automatic remote *operation*, *control* or *protection*.

Completely transistorized with printed circuits, the Westinghouse carrier provides a new standard of reliability. In addition to remarkably low maintenance, this unit draws only one-tenth the conventional power, requires but one-twentieth the space. Interchannel interference virtually disappears, allowing more, fully reliable channels in the same band width.

A new concept in distance relaying

The advanced design . . . K-Dar system

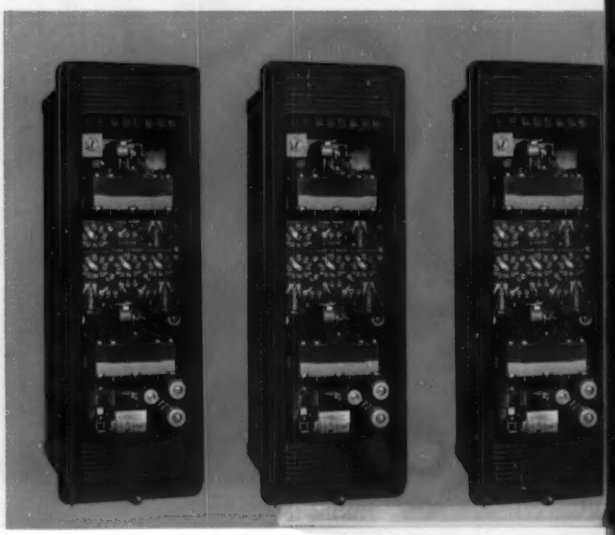
System interruptions on supervoltage transmission lines will be mighty expensive. Damage and outage due to sustained fault current cannot be tolerated . . . nor can the costly repair bill which follows.

The new Westinghouse K-Dar protective relaying system, combined with Westinghouse carrier or micro-wave, provides high-speed simultaneous relay operation at both ends of faulty line sections, permitting maximum service continuity, faster reclosing and improved system stability.

The K-Dar system is the result of wide application and design experience of Westinghouse engineers in Relay, Switchgear, Industry Engineering and associated departments.

The K-Dar distance relay system has a range of 0.75 to 20 ohms and can be set to protect 90 percent of a line section when used as a distance relaying system without carrier transmission. CP-1045

Advanced design, simplified settings, low-burden and high-speed operation add up to reliable protection, ease of application and low maintenance costs.



YOU CAN BE **SURE**... IF IT'S

Westinghouse

Sales Research in the Age of Precision

Our time has many labels. It has been called everything from the Atomic Age to the Age of Suspicion. It is a time when the sheer complexity of living increases and presses in from all sides. Survival, whether we are talking about individuals or businesses or civilizations, depends on making the right decisions at the right times. In that sense the present era is an *Age of Precision.*

We are finding every facet of our activity yielding to pressures for increased efficiency, productivity, exactness. So far as the operations part of the electric utility business is concerned —the design, the engineering, the rate-making— there is nothing new or strange for us in these pressures. We have always relied on mathematics, scientific discovery, experimentation in these fields.

Not so the selling side of our business. Here the approach has been more casual, imprecise, even haphazard. We have grown accustomed to what we like to call a "traditional growth rate", and we think, smugly, that we're quite comfortable with it. There is no mystery in this: It is simply the mental by-product of an industry lifetime during which, by and large, we could sell everything we generated.

It may not always be so. If this is an Age of Precision, it is so because conditions change so rapidly and radically that in order to survive in it, our actions must have a measure of predictability. This is not becoming so in sales. It is already so.

Market and sales research is the proof.

Practically every major industry (and a few minor ones) engages in some kind of research as a guide to its sales planning.

Now it will be said that we do also. This is so, but do we go far enough?

We like to refer to yardsticks, such as average annual use, but do we break that useage down into classes of customers relative to their income and community position? We point to load factor; growl if it's low, and smile when it's high. But have we allowed it to become a restriction rather than a guide?

Have we, either as an industry or as individual utilities, gone out and performed the sales research in depth that we need in today's market? Can we answer the question: "What do our customers in such-and-such income group think of our company?" How many of us are aware of some of the new probing techniques, like motivational research? Have we thought about them for our own purpose?

Do we know what our customers' children think of us? These are the all-important people upon whom so many of our glowing predictions depend. We wonder.

Yes, we wonder about these matters and a good many more. We wonder whether it isn't time for a long look at our sales practices and techniques—upon which our entire industry depends—with a view to bringing more exactness, more predictability of results into them. We think that this can be done with thorough, scientific sales research programs.

We think it has to be done in this Age of Precision.

Dems Fumble on Brownlee Play

Idaho Power Co gets go-ahead on financing despite Murray and Magnuson's move to block 'unconscionable subsidy'

Despite efforts of two Democratic senators to block the action, the Federal Power Commission has approved a financing plan of Idaho Power Co's Hells Canyon project.

FPC authorized the company to issue $15 million of first mortgage bonds and 225,000 shares of $10 par value common stock. The financing is associated largely with Brownlee Dam construction.

The grandstand play came from Sens Warren C. Magnuson (Wash.) and James E. Murray (Mont.). In a jointly signed letter to FPC Chairman Jerome K. Kuykendall, they protested any "cursory granting" of the financing authorization.

The basis of the senators' action, they claimed in their letter, was that Idaho Power would have a surplus of power in 1958-59 which it would be unable to sell. They contended this surplus would total 300 Mw and if this capacity was not to stand idle it would have to be marketed in the Northwest Power Pool area. But there was no market here, they implied.

The letter did not allude to load growth projections for the area nor did it note the expiration of a power plant lease which Idaho Power has with Utah Power & Light Co (EW, July 27, 1953, p 80). When this expires in October, 1958, it will take 105 Mw off Idaho's system capacity.

Comparison Ignores Load Factor

The senators claimed further that the FPC examiner had found Brownlee power will cost 7.6 mills, "nearly four times the going rate in the Northwest Power Pool area where the Bonneville Power Administration 'postage stamp' rate is 2 mills."

(This postage stamp rate is based on 100% load factor, a point often ignored by federal power exponents.)

"Is Bonneville to purchase this power at its cost and absorb the loss required to transmit it the great distance from Hells Canyon into the Bonneville system and then sell it for a 70% loss at the postage stamp rate?" the letter asked.

"Clearly, Bonneville would find it impossible to justify such an unconscionable subsidy simply for the purpose of making the Brownlee project feasible."

Yet without such a contract, the senators continued, it appears that most of the power from Brownlee will go begging, thus destroying its economic feasibility.

In approving the financing, FPC pointed out that it had fully considered this matter during the license application hearing. At that time FPC found Brownlee economically feasible. Furthermore, said FPC, this decision has been upheld in the courts.

In a parallel move, Sen Murray wrote to the Securities & Exchange Commission urging that Idaho Power's registration statement for the financing not be approved.

Proceeds from the issues, estimated at $22 million, will discharge, in part, short-term borrowings now outstanding that provided interim financing for construction.

Democrat Picked for TVA Post

President Eisenhower has finally filled out the Tennessee Valley Authority board of directors. He appointed Dr. Frank J. Welch, dean of agriculture of the University of Kentucky, to the vacancy.

Welch, 55, is a Democrat. A Texan by birth, he succeeds the late Dr Raymond R. Paty. The recess appointment to the $20,000 a year post will be subject to Senate confirmation in January. Paty's unexpired term runs until May, 1960.

Observers believe the Welch appointment may have the effect of taking the pressure off Arnold R. Jones, a recess appointee who failed to get Senate confirmation before adjournment. Anti-Jones Democrats stalled on his confirmation. Their theory was to force a recess appointment and give TVA supporters time to see Jones in action and decide on his '58 status.

Reluctant at first to take the job, Welch will encounter no such troubles as met by Jones, Washington observers believe. Welch apparently is acceptable to TVA and federal power supporters.

The Kentuckian is highly regarded by both Republicans and Democrats. Since 1935 he has been a member of the agricultural research policy committee of the Department of Agriculture.

WELCH: Reluctant at first

The board will now consist of two Republicans — Chairman Herbert Vogel, Jones—and one Democrat.

Commissioners, weighing inflation and high interest rates, ask . . .

Will Utility Rates Keep Climbing?

It's almost a sure thing, say NARUC members at recent meeting. State regulation of atomic power plants gets close scrutiny

Higher utility rates are in the offing. This was the feeling of state commissioners attending the annual meeting of the National Association of Railroad and Utilities Commissioners in Memphis recently.

The renewed impact of inflation on operating costs, the committee on rates of public utilities said, along with the higher cost of new capital, will most certainly "exert a double pressure for upward revision of utility rates." This is especially true in the case of a utility that is faced with the problem of major plant expansion to meet increasing service demand.

Lacking any offset, the committee report continued, earnings adequate today under today's level of utility rates will inevitably become inadequate tomorrow. This appears to be a continuing problem throughout the coming years.

Long Term Plan Seen Beneficial

However, this upward pressure on utility rate levels can be lessened over "the long pull" if utility operations are conducted on a long term basis instead of being tailored to accomplish short term results, said the report.

Utilities can mitigate these upward pressures in various ways, including:

- Constructing a utility plant on a "wholesale and stabilized basis," with the ultimate usage as the determining factor. As a result, utility service "can be produced over the life of such plant at a cost lower than would be required if the plant were constructed on a piecemeal, start-stop basis." (However, the report warned that although this plan has favorable long range cost implications for the utility customer, the utility itself would be involved in 1) higher initial capital committment, 2) a resulting depressing effect on current earnings, and 3) the assumption of a longer term risk.)
- Expanding research activities and inaugurating a program of long range employee training. Both programs would tend to increase efficiency in the future, even though present expenditures would necessarily reduce current earnings.

Short Term Plans Safest if Earnings Are Low

The committee emphasized that these programs can only be adopted with safety if earnings are at an adequate level. If the utility's management considers its present earnings inadequate, it said, they would be wise to adopt only short term plans, which minimize risk and the immediate impact on earnings.

Regulated utilities, unlike unregulated industry, is just beginning to recognize this particular function per-

formed by adequate earnings, the committee pointed out.

In industry, it said, earnings in many cases have afforded management the opportunity to operate for the long pull. This has resulted in production, on a quality-price balance, of goods that the consumer prefers. "It may be that commission consideration of those factors should enter into utility rate fixing," it suggested.

Other points brought out in the rate committee report are:

Rate Base—A marked trend is indicated "toward greater consideration of 'current cost new' in the determination of the rate base against which public utilities are tested." There are 14 states using and recognizing "reconstruction cost new" values in varying degrees in testing the reasonableness of earnings.

Rate of Return—One of the most important problems confronting regulatory commissions in determining a reasonable rate is the present high cost of money.

Conley, Thornton plan for future as . . .

New Officers Take the Reins

Edward R. Thornton (right) of the New Hampshire Public Service Commission was elected to serve as 1958 president of NARUC. Other new officers are:

First vice president: John B. Conley (left), of the Pennsylvania Public Utilities Commission

Second vice president: LeRoy B. Leibrand, New Mexico PSC

General Solicitor: Austin L. Roberts, Jr

Secretary-Treasurer: Everette Kreeger

Turning to nuclear power, Ray E. Untereiner of the California Public Utilities Commission and chairman of the committee on nuclear energy in the electric industry, said: "More than 75% of our total electric power is developed in large steam plants—most of it at a cost of five mills or less per kwhr." The most optimistic estimates for atomic plants, he continued, "do not get the costs below about 10 mills per kwhr within the next ten years."

States may soon have the responsibility for regulating atomic power plants, committee report said, to protect the public health and safety, and to protect workmen from hazardous working conditions as well as to regulate the transportation and disposal of radioactive materials.

To do this, the committee continued, it is important that the states arrive at policies and rules that are in harmony with each other so the necessary compatibility can be attained with no encroachment on state autonomy.

Atomic Energy Costs Treated as Operating Expense

Regarding the rate treatment of atomic power, the committee feels at present that it would recommend that high cost energy from this power should be provided for in operating expenses the same as for any other source of energy. As an alternative, this extra cost could be considered as a part of research and experimentation subject to just and reasonable provisions of applicable statutes.

The feeling seems to be general, Tyre W. Burton of the Missouri Public Service Commission and a member of the nuclear energy committee, said that public utilities have a responsibility to participate in research and development work which is aimed at the eventual commercial use of nuclear materials for the generation of electricity.

Nuclear Plant Accounting Draft Readied

The way to handle the accounting for nuclear plants was brought up by the committee on accounts and statistics. It reported that it has appointed a special accounting subcommittee, which has prepared a tentative draft of the plant and expense accounts believed suitable for inclusion in the NARUC electric system of accounts. A meeting has already been held with representatives of the Edison Electric Institute to discuss this draft and another meeting will be held in the near future.

Retiring Pres John C. Hammer, who opened the meeting, said:

"We must not forget that there are people right here in America who are working day and night to break down our way of life and forever destroy the very principles upon which our nation was founded."

The convention approved a resolution submitted by A. R. Colbert, chairman of the committee on accounts and statistics, that records of utilities be preserved in accordance with those adopted by the Federal Power Commission in its "Regulations to Govern the Preservation of Records of Public Utilities and Licensees," dated April 1, 1957.

The convention voted to hold its 1958 meeting at the Atlanta-Biltmore Hotel, Atlanta, Ga., on Nov. 17-20.

A Boost for Hydro: Alabama Is Through Waiting—Bouldin

BOULDIN: A 100-year wait

Walter Bouldin, president of Alabama Power Co since September, is a lawyer-turned-utilities executive.

It was only five years ago that he joined Alabama Power Co as financial vice president. But his association with this Southern Co affiliate was even then of 24 years standing. For as a member of the Birmingham law firm of Martin, Turner, Blakely and Bouldin, Walter Bouldin had been Alabama Power's legal counsel. Then in 1955 he was elevated to the executive vice presidency and this year assumed the presidency.

A native of Scottsboro, Ala., and a 1928 graduate of Harvard Law School, Bouldin speaks with the ease and confidence of the successful Southern businessman.

A subject which Bouldin enjoys discussing is Alabama Power's development of the Coosa and Warrior rivers.

"The Coosa River development, which we have just received a license from the Federal Power Commission to begin, is something the people of northeast Alabama have been waiting on for 100 years."

The license provides for construction of four new dams and enlargement of the existing dams at a cost of $120 million. When completed, the power project will stretch from Wetumpka, Ala. (near Montgomery) to Rome, Ga.

Basic provisions will also be made in these dams for locks, looking toward the day when the Alabama-Coosa Rivers will be navigable from Mobile, Ala., to Rome, Ga.

Bouldin speaks with pride also of Alabama Power's plans to build the largest dam in Alabama in its $37-million Warrior River development. The dam will be about 300 ft high. Among Warrior development benefits is an additional industrial water supply for Birmingham.

Bouldin is accustomed to success. A Phi Beta Kappa in college, a highly-respected corporation lawyer and now Alabama Power's chief, Bouldin is confident of the utility's future.

A Look Ahead: Utilities Must Grapple with Bigness—Ebdon

EBDON: "...diminishing returns..."

The big problem facing utilities in the future, as a boiler manufacturer sees it, is what he calls the "bigness factor."

H. G. Ebdon, Combustion Engineering Inc's new president, says he believes it will become increasingly hard for utilities to double enormous capacities every ten years.

To cope with this bigness factor, he told EW, utilities must:

- Expand tie-ins with grids (". . . no system of its own can afford the standby capacity it will need.")
- Capitalize upon available station sites (". . . but more and more plants will be built closer to the source of fuel.")
- Improve electric distribution (". . . I believe—but don't really know—that the generation of power has stepped ahead faster than the transmission of power.")
- Seek higher rates (". . . we've passed the point of diminishing returns in holding down rates.")

But though he sees a "bigness problem" for utilities, Ebdon sees no similar problem for equipment manufacturers. Combustion Engineering's answer to bigger and bigger boilers will be the application of present ideas.

"Our first 200-Mw unit actually was two 100-Mw units—two separated boilers with a tied-in circulation system," the vigorous ex-salesman said. "So we were working with known designs. Since then we've brought out a single 250-Mw unit, and the likelihood of 750-Mw units doesn't faze us. We see three units tied together."

But he pointed out that "if manufacturers are to make these big units, they must get more money per unit to help with the financing aspects." In this time of inflation, that means progress payments as well as higher prices.

"The boiler industry nets 4%," he stated. "We can't make enough money to do the research we must

(*Continued on page* 79)

Law of Supply and Demand Brings

- **Estimates of nuclear capacity scaled down to 6,000 Mw for 1968; this may still prove optimistic**

- **Water type reactors suggested at Atomic Forum; big plants are only answer to competitive costs**

Revision of our atomic energy industry seems evident from comments made in and particularly outside of meeting rooms at the recent Atomic Industrial Forum at New York. The reason for this change is elementary—the old law of supply and demand has crashed through the glamorous skin of the atom. The lure of the mysterious atom and the urging of the Atomic Energy Commission brought many companies into the nuclear power business. And although atomic progress has been sure, it has been slow. So today there are too many willing manufacturers and too few customers.

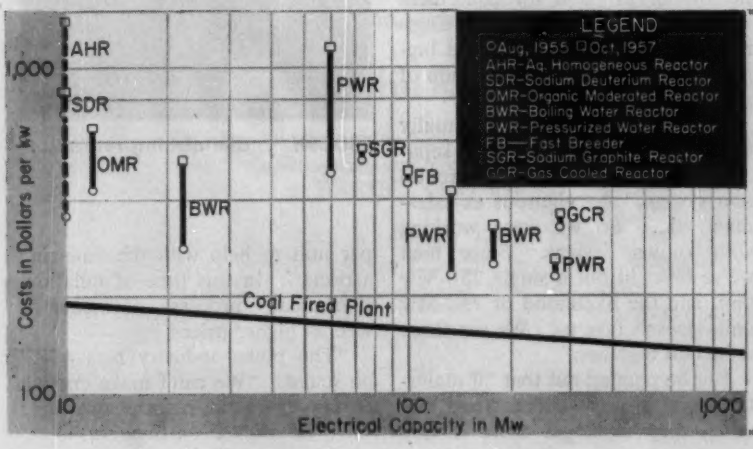
In fact there is only one customer of any size to speak of—the AEC. And it has not provided enough orders to justify the existence of so many suppliers. According to W. K. Davis, chief of reactor development for the commission, the AEC recently received 46 proposals for a small power plant. This is in a field where about half a dozen companies traditionally provide the necessary heavy power equipment.

This spirit of realism, or pessimism as some at the meeting chose to call it, is accentuated by an industry status report prepared for the Forum by Pickard-Warren-Lowe Associates. In hitting the highlights of this report (soon to be published by the Forum), Fredrick Warren predicted a maximum nuclear capacity of 6,000 Mw for 1968 with minimum figures about one-third of this volume. Even this maximum prediction is well below previous estimates, most of which have been in the 10,000-Mw range for 1968. Warren's year-by-year chart of nuclear additions showed a gradual increase in capacity added up to '60, than a sharp drop followed by another gradual rise to a 6,000-Mw-maximum total in 1968.

Perhaps these predictions will even be considered by some as optimistic when a close look is taken at predictions of capital costs. The survey puts a price tag of $430 per kw on the major power reactor plants now being designed or constructed. This is based on the best available data for these current projects and includes indirect costs and interest during construction. With this as a base, Warren and his associates predict a maximum and minimum range of capital costs, in terms of 1957 dollars, of $360 and $280 respectively for large nuclear plants in 1968.

(Electrical World's recent 10th Steam Station Survey put the average cost of modern conventional plants operating in 1956 at $146 per kw. And what is probably even more significant, 90% of the reporting plants were built for $220 per kw or less—well below the projected minimum for 1968-nuclear plants.)

Of course capital costs give only half the picture. Fuel costs, the other big item in power costs, could



Capital Costs Can Be Cut By Building Large Plants

The slope of the band of nuclear plant costs is considerably greater than that for coal fired plants, said James Lane. The Oak Ridge National Laboratory scientist told Atomic Forum nuclear plants tend to become more competitive with increasing plant size. This suggests building very large plants as a means of reducing unit capital costs. Reactor type apparently does not influence overall costs.

Reappraisal of Troubled Atom Industry

be the key to economic nuclear power. But although the fuel cost figures given in the survey are more encouraging than the capital figures, the "average" costs still go against the atom.

W. W. Lowe, presenting fuel cost predictions, put slightly-enriched-uranium water-reactor fuel costs in a 3-to-5 mills per kwhr range in the late 1960's. This compares with a fuel cost average of about 2.6 mills for modern conventional plants operating in 1956.

Behind these predictions is an assumption that industry and government will continue to contribute to non-economic power developments by fostering research and development. At present industry and government are spending about $150-180 million per year in this category. With most major utilities in some phase of nuclear power development, and most manufacturers apparently extended to the limit of their research and development funds, it appears that more government sponsored projects are in the wind. One thing is certain—most of the talk at the Forum points to a reappraisal of the nuclear industry in both industry and congressional circles.

Field Day for Proposals

This is indeed evident in the number of "proposals" offered at the Forum meeting. W. K. Davis of AEC suggested concentration on water type reactors so that we can have competitive nuclear power in the next ten to 15 years even though this may require slowing down our effort on more advanced types of reactors. Davis favors water reactors as the best bet for the short pull because we have had most of our nuclear experience with this type. This is significant. It suggests swinging from a broad frontal attack on the problem to a concentration approach similar to the British concentration on gas-cooled reactors. And although Davis used a very broad definition of water reactors, companies interested in sodium reactor systems and homogeneous and liquid-fueled reactors would certainly get less assistance under this setup.

Other suggestions offered were:

- Concentration on reactor systems which are most applicable for very large scale installation.
- Build reactors abroad.

James Lane of Oak Ridge National Laboratory came to this first conclusion after studying the latest available cost information. Lane's data showed, to nobody's surprise, that nuclear plants now in the design and construction stage are going to cost much more than originally contemplated. But it also showed that there is an apparent lack of dependency of the reactor type on overall plant costs and that size does have an appreciable effect.

Lane did not specify which reactor we should concentrate on, as Davis did. But it could be inferred from Lane's statements that it certainly would be one of the types we are now working on because he felt the possibility of finding another new reactor system with appreciably lower costs seems remote.

Building reactors abroad made sense to C. H. Weaver, Westinghouse Electric Corp. It appears to him that "we do not require and cannot justify" a large number of nuclear plants in the U. S. to meet our development goals. He suggested that "such reactors can just as well be built abroad" where they are needed. Some engineers agreed with the logic of this statement but most felt that federal power advocates would not agree if it involved government money.

Everyone seemed to agree on one thing about nuclear power economics—cheap nuclear power will come from large plants and a continual uprating of plants as they go on the line. Lane cited figures from the British program to support this contention—$657 per kw for the 70-Mw Calder Hall gas-cooled plant vs a predicted $308 per kw for the 500-Mw Hinkley plant of the same type.

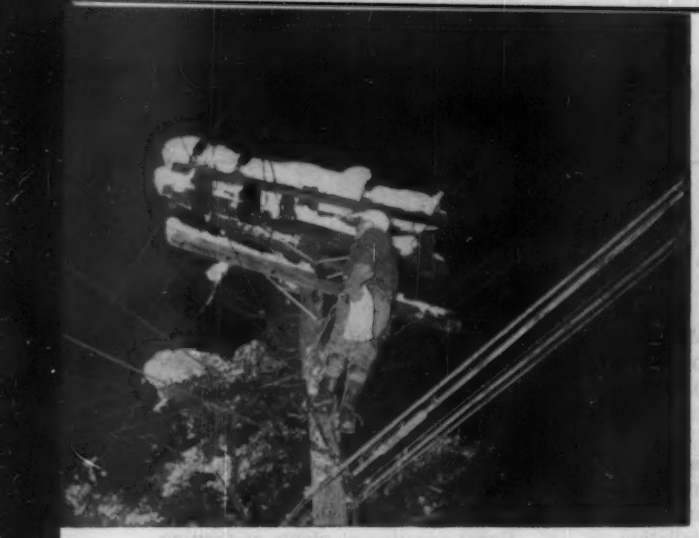
The "something-for-nothing" angle is all but a reality. Davis said, ". . . on the basis of findings to date on the operation of the Experimental Boiling Water Reactor (Argonne 5-Mw) we think the margin for increased power production is four times design power level". And a spokesman for the General Electric Co said, in reference to the 5-Mw Vallecitos reactor, "We've already reached our maximum licensed output and are sure the reactor can do much better." Technical people at the sessions are confident that reactors now under development will also be able to produce power in excess of their design ratings.

With all the emphasis on a reappraisal of our nuclear policies, technology took a back seat. Walter Zinn, General Nuclear Engineering Corp, found our research and development program "broad, deep and vigorous," however.

NUCLEAR NOTES

New group, American Nuclear Power Associates, will explore building of liquid metal fueled, gas-cooled power plant. Members are Rockland Light & Power Co, Burns & Roe, Inc, Griscom-Russell Co, Clark Bros Co and Raytheon Manufacturing Co.

Sodium Reactor Experiment near Los Angeles was dedicated last Thursday. Constructed for AEC by Atomics International, the plant has electrical capacity of 6,500 kw. It is a forerunner of a 75,000-kw SRE to be built for Consumers Public Power District of Columbus, Neb.



"Brainstorms" Help Prepare For Snowstorms

After a spring snowstorm, Utah Power & Light Co called a brainstorming session. Result: Nine good ideas for use this winter

Thanks to "brainstorming", Utah Power & Light Co storm-emergency operations will be more effective the next time nature strikes.

A heavy spring snowstorm lambasted Salt Lake Valley April 23, wreaking havoc with distribution and services. After the outages had been restored, UP&L enlisted 35 key veterans of the operation to recap their efforts in a free-wheeling brainstorm meeting. Ideas born in that session are now bolstering emergency procedures.

Weather forecast for April 23 was "scattered showers and snow flurries", routine for that area.

But April 23's wee hours felt the spring storm lashing the valley with fury. Tree limbs, already budding, snapped under their burden of moisture-laden snow and crashed into power lines. Utility poles and wires broke under unaccustomed loading.

Salt Lake Division's trouble desk routed out emergency crews. Customers, still abed, placed so few trouble calls that outages could not be pinpointed, so most of the crews were placed on restless standby.

A flood of calls broke on the desk at 6 am. By 8:30 every man was working. Snow continued to fall. Emphasis was on clearing broken wires to prevent serious injuries.

Crews came in from outside divisions, from different departments. Trouble gangs, 137 men in 36 crews at peak, worked steadily. By early morning of the 24th, all major power and line failures had been restored; by evening, all customers again had service. Some crews had worked 28 consecutive hours.

Recorded jobs included: five poles replaced, ten stubbed; 261 fuses changed; 181 junction fuses replaced; 106 primary and 214 secondary line breaks repaired; over 1,000 services restored.

Performance was good. But it might have been better. Suggestions were in order, and who could better make suggestions than pivotal troublemen who had experienced the operation?

Key Men Called Together

Vice President Joseph E. Cushman huddled with Salt Lake Division Manager James C. Littlefield. Deciding that a "brainstorming" session would provide the free-and-easy atmosphere required, they elected to delay until damage and restoration were appraised. Then they called in 35 key people who'd fought the storm from truck or desk.

Cushman outlined the meeting's purpose and emphasized necessity of free discussion. Littlefield recapped storm and damage, then introduced experts who examined specifics—weather forecasts, trouble desk operations, distribution construction, communications. After each brief, the subject was tossed to the group.

Comments were uninhibited. Wild ideas were proposed, kicked around. Some were added to, modified, found not so wild after all. None were discarded or even criticized; all were passed on to an evaluating committee.

Nine supervisors, comprising the committee, met immediately to weigh the ideas. Their impression: brainstorming gives some weird approaches, but it's easier to tame down ideas than to think them up.

From the batch of suggestions, the committee gleaned the nine below. They will be in effect this winter.

Here Are Concrete Results of UP&L's Brainstorming Session

1. Key personnel will receive weather reports twice daily.
2. During storms, men will be posted early at substations affected.
3. Crews will be set up in advance for meeting specific emergencies.
4. Trained Substation Dept linemen will be made available, equipped with light truck, emergency fuses, and fuse stick kits.
5. Emergency equipment, including fuses and fuse stick kits, will be prepacked for loading on spare vehicles from other departments.
6. An extra set of trouble room circuit maps will be issued each trouble crew for the areas it is working.
7. Phone circuits between headquarters and service center will be divided into two differently-routed cables.
8. Salt Lake Div will get a special mobile-radio channel.
9. Vertical secondary spacing will be studied in an effort to reduce conductor kissing during storms.

Another Rise in Raises

Salaries for engineers are still going up, although at a slower pace than in the past few years.

A recent American Management Assn survey shows an average pay increase of 5.9% for engineering, scientific, and administrative workers from June 1956 to June 1957. This compares to 8.6% for the period ending June, 1956.

Highest salary increases for the year went to quality control engineers, who averaged 7.9%. Electrical and mechanical engineers also fared better than average, with increases of about 7.5%. Lowest on the list were systems and procedures analysts, whose raises averaged 3.8%.

The range of median annual salaries ran from about $5,400 in the lowest or entering category (engineers with B.S. degree and less than one year experience) to about $13,100 at the highest non-management level (experienced engineers engaged in planning, conducting, and supervising of large or important projects).

Defining Terms

The term "public power" is misleading, according to National Association of Manufacturers' advisory board. Its use in the past 20 years has aimed to convince the average citizen such power is in the public interest, NAM says. "Actually, the only thing 'public' about such power is that everybody pays the subsidy." The advisory group suggests using 'federal' or 'government' power instead.

A Reverse for Pump Storage

Union Electric Co has canceled its plans to build the proposed pump storage project on Establishment Creek. Extensive studies, reports Executive VP Dudley Sanford, showed that "this project cannot be economically justified as our system is now constituted."

The project, which would have generated 800,000 kw, was proposed last year (EW, Aug. 13, '56, p 8).

Desalting: A Load Builder

A possible large user of electricity in the future will be the saline water conversion field.

The relatively new desalting method called electric membrane demineralization lists electricity as one of the two principal operating costs. While the amount of electricity consumed depends on the amount of salt removed from brackish or sea water, the process, on the average, requires about 7 kwhr to remove 1,000 parts per million of salt from 1,000 gal of water.

Other recent development in the desalting field:

- Methods of using partly spent low-temperature steam from electric generating stations for the distillation are being studied by seven California utilities and Dept of Interior. The group is considering erecting a pilot test plant in California.
- Estimated cost of conversion has dropped from 1953's lowest estimate of $1.50 per 1,000 gal to $.60 or even less today.

Pistol Packers – Utility Style

In an attempt to win a modified "survival of the fittest" contest down in Roodepoort, South Africa, electric meter readers have been armed with weapons designed to ward off their natural enemy—the dog.

The weapons, to be used only in an emergency, are gas pistols of a harmless but effective variety. They have been supplied to two meter readers as an experiment, following an appeal to the town council six months ago. The local meter readers had been plagued by attacks from dogs for several years.

A Look Ahead: Utilities Face Bigness (*Continued from page 75*)

do. It's up to utilities to keep the manufacturers healthy."

Higher equipment prices and other financial problems mean more utilities will have to seek rate increases, Ebdon believes.

Looking at the somewhat-cloudy atomic scene, Ebdon sees the main cause of spiraling nuclear-plant prices as "ignorance on the part of the buyer and builder." The builder, he said, bid on what the buyer called a "conceptual" design. But actually the design turned out to be merely a "conception" of a "conceptual" design, he said.

"It was late in the embryonic stage before the builder found out he had sired quadruplets and was getting more than he bargained for."

"There is a long hard road ahead that must be traveled before we master the cost and economic problems of atomic power," Ebdon said. Feasibility already has been proved; only the "dollar-sign" remains. "We not only must—but will—find ways to build atomic power plants on a competitive basis," he declared with conviction.

Joint Use of Transmission Facilities

Hughes tells EEI Transmission & Distribution Committee sharing of facilities results from right-of-way problems

Inter-use of transmission lines and right-of-way in Connecticut will be so extensive in 1965 that "it will be difficult for the respective companies to identify their own property." This prediction of the effectiveness of a joint-use program was made by C. T. Hughes, vice president, Connecticut Light & Power Co, to Edison Electric Institute's Transmission & Distribution Committee at Boston last month.

The group also discussed thermal loading of conductors, an experimental installation of polyethylene lead-covered cable, and extra-high-voltage-cable research.

The Connecticut plan for using transmission facilities to maximum capability, said Hughes, is a direct result of the difficulty of securing sufficient rights-of-way for overhead lines. Participants in the plan are Connecticut Light & Power Co, Connecticut Power Co, Hartford Electric Light Co, and United Illuminating Co.

As these companies are also planning additions of generating capacity on a "one-system" basis, their first transmission agreement provided for facilities to interchange the capacity of the generation contracts. The companies agreed to establish an artery to transfer the largest block of generation contemplated in the next few years. This is 115-kv 4/0 copper or its equivalent. Annual cost of this circuit is borne by the participants in proportion to their peak loads. This results in a transfer capability of 60 to 100 Mw, depending on system conditions at transfer.

In the next two agreements, load was served by one company from facilities of another, Hughes said. The companies arrived at a formula —number of miles times kilowatts of capacity times a constant (10¢) as a uniform method of payment. The transmitting company is responsible neither for the capacity needed by the neighbor nor for line losses.

If the total capability of the jointly used facility becomes inadequate because of load growth of either company, the facility will still be used jointly, Hughes said.

By relying on "ampacity"—a contraction of the phrase, "current-carrying capacity under any stated thermal conditions" — Consumers Power Co has postponed three conductor rebuilds at a total annual saving of $126,000 in fixed charges. Leon F. Murray, of Consumers' general engineering department, emphasized the effect of wind velocity and temperature drop on ampacity.

Ampacity increases 25% for a 3-mph rise in wind velocity and 20% for a 60F drop in temperature (see curves). Nevertheless, Murray noted, these data are tentative: Further study and field experience are needed before final tables on ampacity can be published.

An experimental installation was made recently to determine whether a waterproof cable can be made by substituting polyethylene for paper insulation in lead-covered cable. H. W. King, Consolidated Edison Co, and W. J. Plate, Anaconda Wire & Cable Co, explained that this is a new approach to the problem created when moisture, entering a sheath break, causes failure.

Three Optimistic Predictions Made for

RADIOACTIVITY OF URANIUM BAR held by Earl Ewald (right), vice president, Northern States Power Co, is indicated by instrument held by C. B. Graham of Allis-Chalmers Mfg. Co. Noise from detector went out over microphone

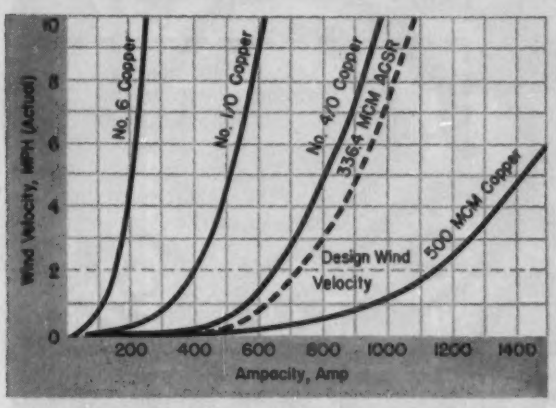
Wisconsin Utilities Association is told atomic station design may be simplified

Some hopeful predictions for nuclear plants were made at the annual convention of Wisconsin Utilities Association in Milwaukee Oct. 16-18. System stability and transformer design were discussed also.

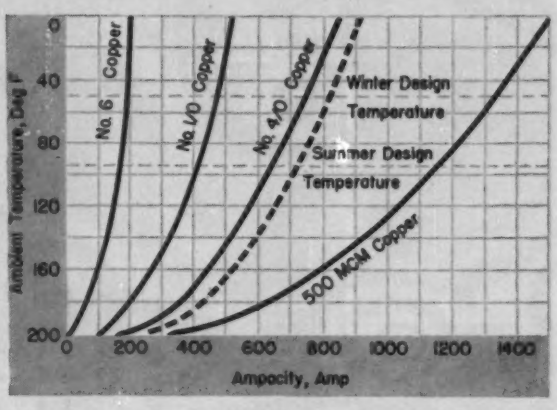
These predictions for nuclear plants were made by C. B. Graham of Allis-Chalmers Mfg Co:

- An inside-the-reactor nuclear

Meets Success in Connecticut



"AMPACITY" INCREASES 25% for a 3-mph rise in wind velocity; it increases 20% for a 60F drop in temperature.



The term ampacity is a useful contraction of "current-carrying capacity under any stated thermal conditions"

Twelve sections totaling 3,500 ft of the 3-c 800-MCM cable were installed this spring on four 13.8-kv network distribution feeders. Tentative conclusions include:

- There is a possibility that polyethylene can be substituted for impregnated paper insulation.
- A 15-kv polyethylene cable can be made in sector shape with reduced diameter; lead sheath can be extruded over polyethylene.
- Polyethylene cable can be designed to carry heavy continuous and emergency short-circuit loads.

A progress report on EEI-AEIC extra-high-voltage-cable research was made by Clement S. Schifreen, cable and insulation research engineer, Philadelphia Electric Co. He said that a three-member team, after visiting Europe, reached conclusions which included:

- Satisfactory cable can be made for operation at 345-kv and higher.
- The EEI-AEIC field testing program is necessary, as European tests are not made under conditions suitable for operation in the U. S.
- No commercial or test installation at 275 kv or higher was loaded to desired U. S. conditions.

T. C. Duncan, EEI chairman of the EEI-NEMA Committee on Higher Secondary and Utilization Voltage, reported that the committee would release in a few months a report recommending a higher secondary voltage.

Nuclear Plants

superheater would raise steam temperatures from 1,000 to 1,200F.

- Containment vessels would be eliminated.
- Plants would be smaller and possibly cost less than equivalent fossil-fuel plants.

Describing the project of Central Utilities Atomic Power Associates, Graham noted that the plant will have a controlled recirculating boiling water reactor. The containment shell will surround only the reactor; the turbine and generator will be outside the shell.

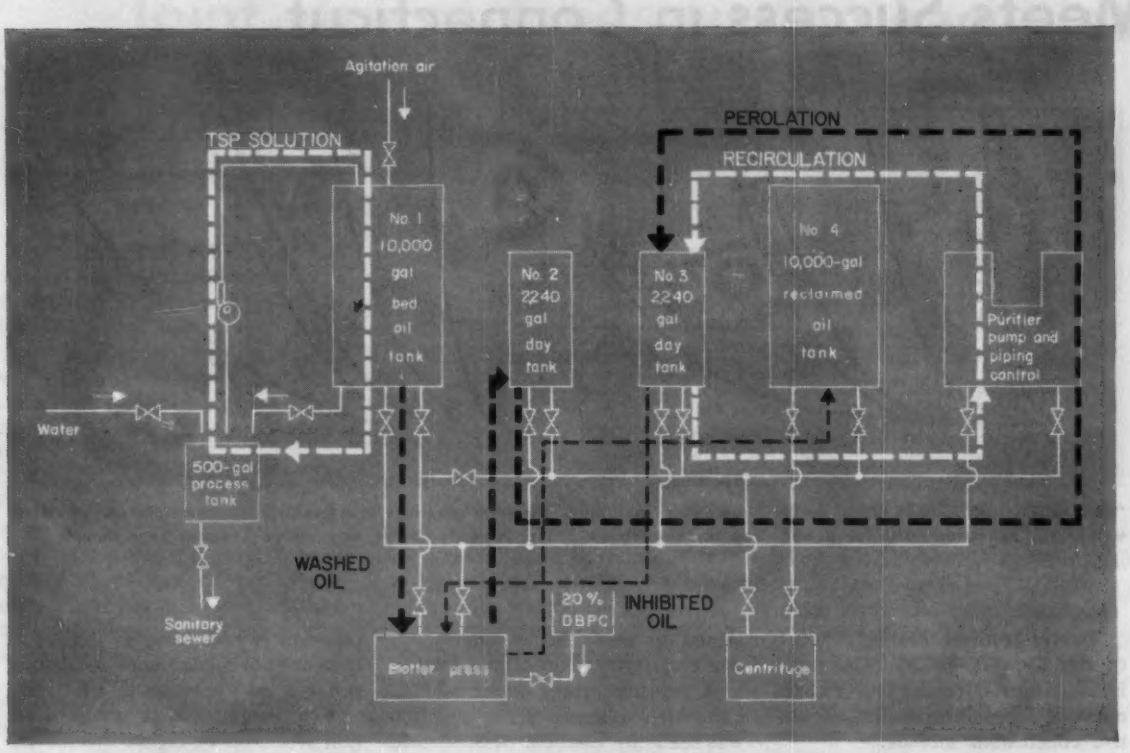
Fuel elements will be completely submerged in water when removed from the reactor. After 30 to 60 days under water to dissipate heat, they will be sent to the government for chemical processing.

Earl Ewald, vice president, Northern States Power Co, commented that many communities have indicated an interest in having the nuclear plant in their areas. However, plant design and location must be coordinated carefully. The design will have to be developed further, the site selected, and then the design completed to fit the location.

The Engineering & Operating Section was warned that system stability is being affected by the trend to larger generators, high-reactance conductor-cooled machines, high-reactance transformers, modern voltage regulators, and more and stronger interconnections. D. M. Sauter, Westinghouse Electric Corp, said that most of these factors increase stability problems and affect system design practices.

Users should guard against the cost of transformers being boosted excessively by refinements not worth the additional cost, said P. B. Speer, Pennsylvania Transformer Co. Also, modification of one requirement frequently changes another—a practice not always desirable.

Loss ratio is a key factor for the designer, for reducing it beyond certain limits increases cost, Speer observed. Noise level is important to the user, but changing it also changes the loss ratio and possibly the cost.



OIL RECLAIMING PROCESS involves washing bad oil with TSP-water solution in tank No. 1. After sludge, water and TSP are drained off, washed oil is pumped into tank No. 2 through blotter press. Then oil is percolated through purifier charged with fuller's earth to tank No. 3. Oil is recirculated between purifier and tank No. 3 until minimum standards are reached. Finally, oil is pumped through blotter press, where DBPC is added, and then delivered to tank No. 4

Oil Reclaiming Process Saves 10.5%

SUBSTATIONS
Maintenance

Virginia Electric & Power neutralizes oil acids with trisodium phosphate before reclaiming with fuller's earth

OLIN R. COMPTON, Asst Supt, Electrical Equipment, Virginia Electric & Power Co, Richmond, Va.

An 11-step process for reclaiming insulating oil saves Virginia Electric & Power Co 10.5% or 0.8¢ per gal. In this process, oil is washed with a solution of trisodium phosphate (TSP) and water to remove acid.

The process eliminates two conditions considered necessary in previous attempts at washing out acid with TSP. These were heating of the oil-TSP mixture to the proper temperature and a large amount of water for washing the oil after treatment. Neither are necessary to the Vepco process. Total cost per gal of reclaiming and inhibiting oil is 6.70¢ compared with 7.49¢ under the former method.

Wash with TSP-Water

The process was developed by Vepco chemists through experimental pilot runs. Oil is washed with a TSP-water solution. After the mixture settles, the water, sludge, and TSP are drained off, and the remaining oil reclaimed.

Reclaimed oil is inhibited with an artificial anti-oxidant to produce an oil with "like-new" characteristics. Chemical actions which take place are neutralization, sequestration, and precipitation of metallic, organic, and metallic-organic impurities.

In greater detail, here are the 11 steps developed by Virginia Electric & Power Co to reclaim bad oil using a TSP-water mixture:

Adapted from a paper presented at the 1957 Doble Client Conference, Boston, Mass.

1. Determine neutralization number and interfacial tension of composite sample from 10,000-gal bad-oil tank.

2. Determine amount of TSP required: Neutralization number X gal of old oil times 0.031 = lb of TSP. The constant, 0.031, was determined experimentally. (As Vepco normally washes 8,000 gal of oil at a time, the equation reduces to 248 times neutralization number = lb of TSP).

3. Mix the TSP with 200 to 300 gal of water in the 500-gal processing tank. When TSP is completely dissolved, pump the solution into the 10,000 gal bad-oil tank. Agitate the mixture with compressed air for 1 to 2 hr.

4. Allow contents of the 10,000-gal tank to settle as long as possible. Minimum settling time is 12 to 18 hr.

5. From the bottom of the tank, draw off water, TSP, and sludge until the quantity equals the TSP-water solution added or until oil appears. Solution is drained into the 500-gal processing tank, allowed to settle 24 to 48 hr, and drained into a sanitary sewer after oil is removed. (Local authorities do not permit oil to enter the sewer.)

6. If the dielectric strength is below 30 kv, circulate the washed oil through a centrifuge. This step is unnecessary when the washed oil is allowed to settle 3 to 4 days, and free water, etc, are drawn from the bottom of the tank.

7. Fill the No. 2 day tank with 2,240 gal of washed oil using a 12-in. blotter press. The draw-off connection on the 10,000-gal tank is 12 in. from the bottom.

8. Place one new charge of fuller's earth in the purifier. Adjust valves to put existing partially spent charge in the first pass. Then 2,240 gal of oil are allowed to percolate from the No. 2 day tank to the No. 3 day tank and recirculate between the purifier and No. 3 day tank for the remainder of the day.

New Process Saves 0.8¢ per Gal over Old Method

	Old Method No Washing	New Process TSP Wash
Time and Material for 2,240-Gal Batch		
Settling, days	....	3
Circulated through fuller's earth, days	5	2
Fuller's earth used, lb	1,250	750
Cost of Reclaiming Oil (Based on 10,310 gal)		
Purifier operation, cents per gal		
Electric energy	0.59	0.313
Oil loss	0.71	0.210
Cranite	1.61	0.480
Labor	0.29	0.337
Bags and Felts	0.05	0.048
Depreciation	0.53	0.532
Sub-total	3.78	1.920
Disposal of used Cranite	0.14	0.050
Testing oil samples	0.13	0.285
Handling inhibitor	2.58	2.580
Handling tanks and drums	....	0.941
Mixing and adding TSP	....	0.316
Supervision and overhead	0.68	0.609
Total Cost	7.49	6.702

9. Draw off composite sample. If neutralization number is 0.1 mg KOH/gm oil or below, and interfacial tension 30 dynes/cm or above, the oil is considered ready for inhibiting.

10. If the oil does not meet the requirements in Step 9, replace the spent cartridge in the purifier with a new charge. With valves reversed, continue the circulation with frequent tests until minimum standards are reached.

11. Reclaimed oil is inhibited by adding a 20% solution, by weight, of di-tertiary-butyl-paracresol in good oil to the reclaimed oil. The 20% solution is introduced into the drip pan of the filter press, with the drip-pan drain valve cracked so as to introduce 1.5 gal of 20% DBPC solution into each 100 gal of oil. As the process goes on, inhibited oil is pumped through the blotter press into the 10,000-gal reclaimed oil tank.

To evaluate the cost savings of the oil reclamation program, a special accounting procedure was used. All charges applicable to oil reclamation, including fringe benefits and overhead, were charged to a continuing job order. This account was cleared each month by allocating the charges to the proper operating accounts.

Costs Detailed

Costs for reclaiming and inhibiting bad oil under the old method and under the new process are shown in the accompanying table. These costs are based on similar quantities of oil of comparable quality reclaimed during April, 1954, and September, 1956. The costs are actual expenses involved, not adjusted for subsequent increases in labor and materials. It should be pointed out that the costs of handling and cleaning oil drums and tanks are included in the figures for 1956 operations but not for operations in 1954.

Maximum Continuity Gained by

TVA relays to isolate deficient areas, shed load, and protect equipment and plans generation and tie-line loading

C. L. KARR, Director of Power Operations,
C. P. ALMON, JR, Chief, Power Systems Operation Branch, Tennessee Valley Authority, Chattanooga, Tenn.

Maximum continuity of power supply on the Tennessee Valley Authority system requires relaying to clear faults, shed load, and protect equipment. Accurate estimating, scheduling, and control of loads and generation contribute to lowest cost of delivered power.

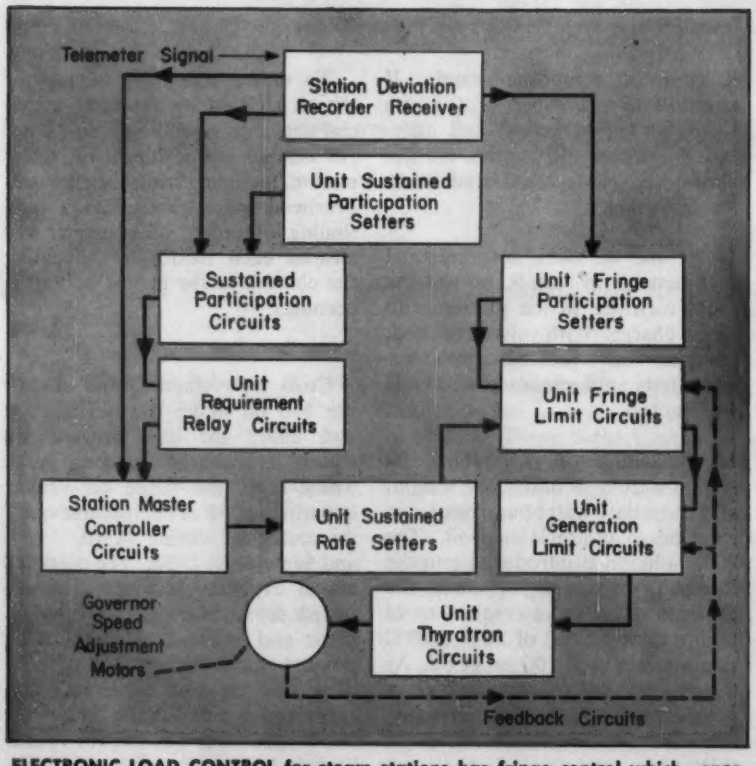
Maximum system load was 9,239 Mw during January, 1957, supplied to 196 private and public customers. Through interconnections, TVA is part of a 50,000-Mw network comprising the middle third of the country and more than 100 control areas.

Adapted from a paper presented at the 1957 American Power Conference sponsored by Illinois Institute of Technology

Adequate relays and automatic reclosing equipment play a major role in isolating faults and restoring normal connections rapidly.

Admittance-type distance relays with auxiliary equipment and high-speed reclosing (except when the line is not within transient stability limits) permit maximum power transfer under all conditions and provide for isolation of a deficient system part.

Some underfrequency relays cut off selected industrial loads under abnormal conditions to balance load and generation. Such schemes include automatic load restoration after allowance for the increased loads. During low-frequency conditions, auxiliary power at some stations can be transferred to an outside source or supplied by a generator isolated to feed local load.



ELECTRONIC LOAD CONTROL for steam stations has fringe control which operates almost instantaneously to handle rapid load changes on system's tie lines

Protective relays on large turbo generators remove the units in the event of excess load or low frequency. Relays are coordinated with load shedding so that machines are not removed when automatic load reduction initially balances generation with load.

Load shedding covers a 388-Mw maximum contract demand load of the Arnold Engineering Development Center to handle instantaneous load reduction. A remote-trip signal is initiated at AEDC by predetermined amounts of load reduction at fast rates, in excess of the 30-Mw-per-min maximum permitted by contract, to shed generation as necessary at five TVA hydro stations. Manual load tripping is directed by the power system dispatchers. TVA has ten large industrial customers that can be shed during troubles.

Load Shedding Beneficial

Load shedding, though infrequent, has proved beneficial to TVA and its customers. In one instance, 677 Mw of generation was lost without disturbing primary interconnections, as was loss of 1,200 Mw of load at another time. Less than half the disturbances were reflected on tie lines; frequency variation did not exceed 0.3 cps; and all ties were on schedule with 7 min.

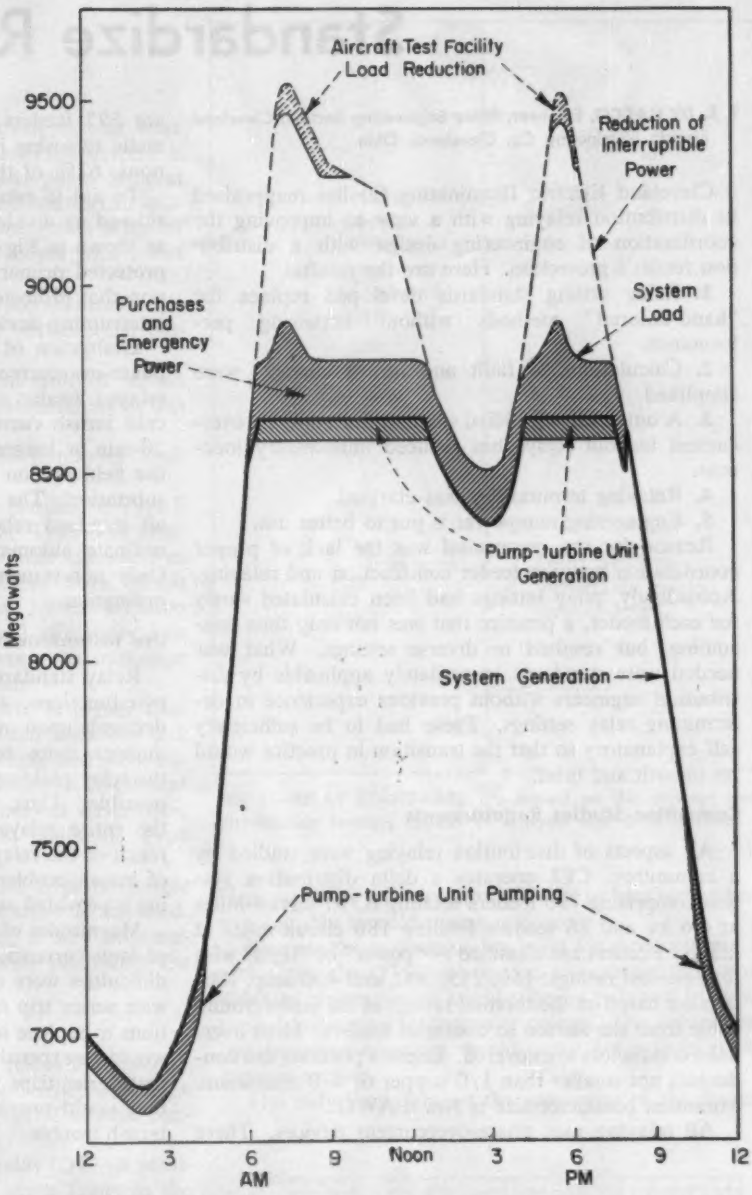
Effective load control requires short and long-range planning. TVA's instantaneous power demands at times change more than ±100 Mw; normal changes are 30 to 60 Mw. These variations are caused primarily by such loads as large electric furnaces and rolling mills, called fringe-type loads. Power demands which vary gradually and generally are predictable are sustained-type loads.

In short-range planning, one-day-ahead hourly loads are estimated and scheduled for generating stations and tie lines to meet sustained-load changes economically. System usage is estimated (within ±1%) by prediction of future loads through correlation of weather conditions and previous hourly loads. Performance of industrial loads is deducted from total load for a similar past period. Basic loads (municipals and cooperatives) are estimated,

considering these factors: Temperature level; wind velocity and direction; light intensity; hours of daylight; weekly load pattern; holiday effect; and seasonal growth. An allowance of 50 Mw is included for fringe-load variations, up to 200 Mw is allocated for peak within the hour, and 250 Mw is provided for spinning reserve to offset loss of the largest generator.

In long-range planning, demand and energy requirements and supply are studied every month for each of the next 12 months. A related weekly study estimates demand, energy requirements and supply for each of the next six weeks. Based on this and estimated flows into each reservoir, an economic balance is determined for delivered cost of power, considering expected limiting factors on the system. The resulting load scheduling among plants sets the operations for the next week.

For calculation of economic loading on a digital computer, TVA uses a system loss formula, based on a set of B-constants, and typical generating schedules for specific loads. Penalty factors are applied to incremental bus costs, and incremental costs of delivered power are obtained. These costs and schedules guide hourly generation on all plants.



EMERGENCY LOAD CURVE for a typical winter day guides operators in shedding load when large generator is lost and high tailwater lowers hydro capacity

Computers to Sharpen Dispatch

Another economic loading method, programmed for a digital computer for the whole TVA system, should give a more accurate and different set of constants, which probably will be used with an analog computer to obtain instantaneous costs of delivered power from any station and provide for continuous economic loading. With this computer designed to permit conversion to automatic dispatching, load and generation data probably will be telemetered to it.

The TVA system, and practically all others in the 100-control-area network, operates on an area basis and allows for some assistance in maintaining the interconnected system frequency. In the TVA control scheme for frequency-bias regulation, boundary tie-line kw signals are telemetered to the Chattanooga dispatching office. The sum or net of these quantities, the tie-line schedule, and the frequency-bias setting can represent the deviation from schedule if tie-line requirements are not met. Eight individual rate setters assure that the rate of change and the proper interchange scheduling with each interconnecting company are met. Deviation signals are transmitted to the regulating stations.

Load is regulated for tie-line load changes at hydro and steam stations by electronic controls. Fringe control at steam stations operates almost instantaneously over a range of ± 3 Mw on each of 20 steam units to control rapid load changes. This range is maintained by controls at the hydro plants and sustained load control at the steam plants. Experience shows the combination of hydro sustained and steam fringe regulation is best.

Standardize Relay Schemes

T. E. DY LIACCO, Engineer, Relay Engineering Section, Cleveland Electric Illuminating Co, Cleveland, Ohio

Cleveland Electric Illuminating Co has reappraised its distribution relaying with a view to improving the coordination of engineering design with a distribution feeder's protection. Here are the results:

1. Relay setting standards developed replace the "hand-tailored" methods without impairing performance.
2. Calculations of fault and inrush currents were simplified.
3. A universal, simplified standard for applying overcurrent lockout relays has reduced unnecessary lockouts.
4. Relaying terminology was clarified.
5. Engineering manpower is put to better use.

Reason for the reappraisal was the lack of proper coordination between feeder construction and relaying. Accordingly, relay settings had been calculated singly for each feeder, a practice that was not only time consuming, but resulted in diverse settings. What was needed were standards immediately applicable by distribution engineers without previous experience in determining relay settings. These had to be sufficiently self explanatory so that the transition in practice would be smooth and brief.

Committee Studies Requirements

All aspects of distribution relaying were studied by a committee. CEI operates a delta distribution system comprising 796 feeders totaling 6,797 circuit-miles at 4.6 kv and 86 feeders totaling 186 circuit-miles at 2.3 kv. Feeders are classified as "power" or "light" with four current ratings: 150, 215, 300, and 400 amp. Ratings are based on the thermal ratings of the underground cable from the station to overhead feeders. Most overhead conductors are covered. Express portions use conductors not smaller than 1/0 copper or 4/0 aluminum. Minimum conductor size is No. 6 AWG.

All relaying uses phase-overcurrent devices. There are 593 feeders (67%) with series trip coils. Automatic reclosing is on all feeders at unattended substations, 62% of the total.

To aid in establishing standards, a feeder was considered as divided into "relayed" and "field" sections, as shown in Fig 1. The relayed section is that portion protected primarily by substation relays; the field section that protected primarily by fuses or other circuit-interrupting devices in the field.

Evaluation of system requirements determined that phase-overcurrent relaying would protect the entire relayed feeder section against short-circuits, tolerate cold inrush currents upon energizing a feeder after a 20-min or longer outage, and coordinate with fuses in the field section and with bus and bank relays at the substation. The last is not a major consideration, as all standard relay settings were chosen so as to coordinate automatically with fuses and station relays. Only non-standard settings need be checked for coordination.

Use Instantaneous to Stop Burndowns

Relay standardization concerned itself with the first two functions, which taken together make conflicting demands upon overcurrent relaying. With covered conductors more susceptible to short-circuit burndown, the relay philosophy always has been to trip as fast as possible. Thus, instantaneous relaying is applied to the entire relayed section whenever practicable. The reach of the relay may have to be pulled back because of inrush problems. Nevertheless, instantaneous relaying is provided at least to the end of the express portion.

Magnitudes of inrush currents are approaching those of fault currents, as shown in Fig 2. Thus, restoration difficulties were experienced on some feeders equipped with series trip coils. Wholesale revamping of substations to replace series trips with time-overcurrent relays would be expensive and sometimes needless. All feeders with series trips were catalogued to determine whether they could provide effective protection and still avoid inrush trouble.

CEICo Develops Guides for Relay Application

"Quick-trip, slow-trip" time overcurrent relaying is standard for new construction.

Instantaneous relaying always is provided at least to the end of the express portion of a feeder.

Use of 2-cycle breakers is planned for feeders with high fault currents in the express portion.

Series trip coils are applicable practically to all "power" feeders.

Addition of 2:1 auxiliary CT's will protect many "light" feeders having high inrush currents.

Time-delay is required for "light" feeders with very high inrush currents.

Reclosing relays on feeders at unattended substations are set for an instantaneous and two time-delay reclosures.

Circuit reclosers may be used on small rural feeders where interrupting duty does not exceed 6,000 amp.

and Settings

Minimum fault and maximum inrush current were determined for each feeder. Minimum fault current is the short-circuit current on a phase-to-phase fault at the end of the relayed section. Maximum inrush current is the estimated current on re-energizing a feeder after a 20-min or longer outage. Feeders with series trips then were classified as:

Type S—Minimum fault current exceeds inrush current and the series trip can be set between the two values.

Type SA—Minimum fault current exceeds inrush current, which in turn exceeds the maximum series trip setting.

Type T—Inrush current exceeds minimum fault current.

Practically all power feeders were classified as Type S and the series trip remains adequate. Type S is illustrated in Fig 3. Most light feeders were classified as Type SA, indicating that most would have inrush trouble. Type SA light feeders may, by the addition of 2:1 auxiliary CT's, be transformed effectively into Type S. This allows a setting between the minimum fault and the estimated inrush current.

Even though minimum fault current is higher than the proposed series trip setting, often auxiliary 2:1 CT's are applicable. They afford a simple and economical solution to the inrush problem, postpone investment in new relays, and extend the usefulness of series trips, still the protective devices easiest to maintain. Type SA is shown in Fig 4.

For Type T (Fig 5) feeders, series trips no longer are satisfactory. Some time-delay feature is required. But when a Type T feeder is rebuilt, it may be transformed sometimes into Type SA, thus permitting the applications of 2:1 CT's.

Select QTST as Standard

With the use of time-overcurrent relays for distribution circuits, a "quick-trip, slow-trip" scheme became standard for new construction. The QTST scheme consists of:

1. An instantaneous overcurrent relay (QT) set sensitive to provide the initial trip for phase faults in the relayed section. After initial tripping, the QT relay trip circuit is blocked as soon as the reclosing relay motor is energized and remains blocked until after the reclosing relay resets.

2. A time-overcurrent, definite minimum time, relay set to pick up faults anywhere in the relayed section with a total time setting of 1.0 sec (total time equals relay time at 10 times pickup plus breaker operating time). This relay protects the feeder from conductor annealing on a persistent fault.

3. The instantaneous unit of the time-overcurrent relay, which is always set to give instantaneous protection up to at least the end of the express. This relay protects the express against burndown.

After the breaker is locked out because of a persistent fault, closing the breaker will not reset the reclosing relay immediately. It takes from 1.5 to 3 sec to reset the reclosing relay from its lockout position.

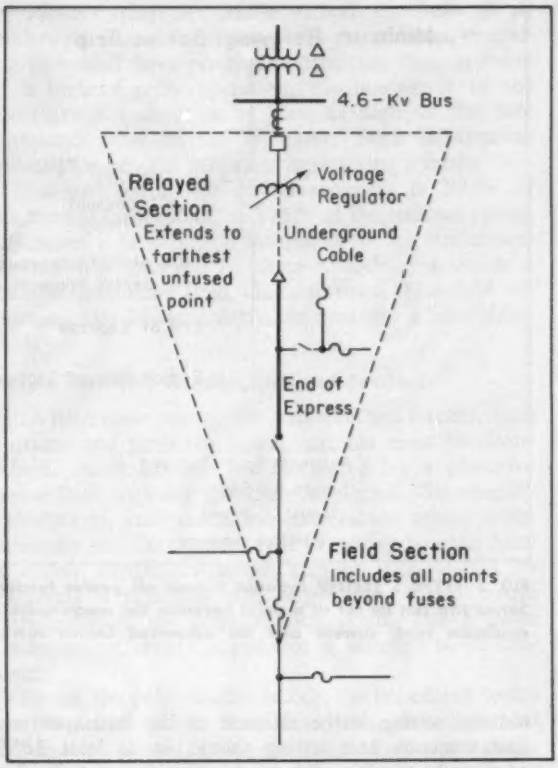


FIG 1—RELAY STANDARDS are based on the concept that distribution feeders consist of relayed and field sections

Hence, the QT trip circuit would still be blocked and no tripping due to cold inrush will occur.

Because the reclosing relay is set for three automatic reclosures, the QTST scheme on a persistent fault provides an instantaneous initial tripping followed by three time-delay or instantaneous trippings. The subsequent instantaneous trippings would occur for a fault in the express section.

The only limitation on the sensitivity of the instan-

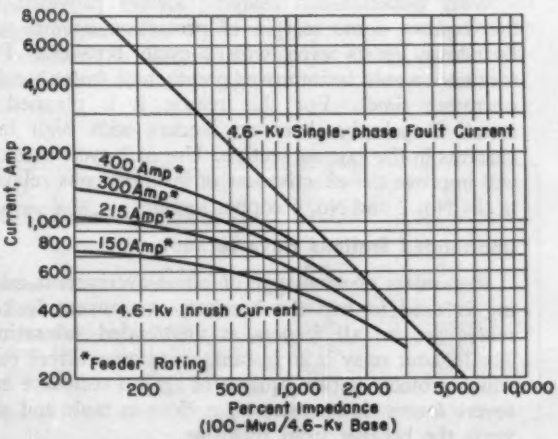


FIG 2—INRUSH-CURRENT CURVES for 4 feeder ratings provide maximum inrush vs impedance to compensation point

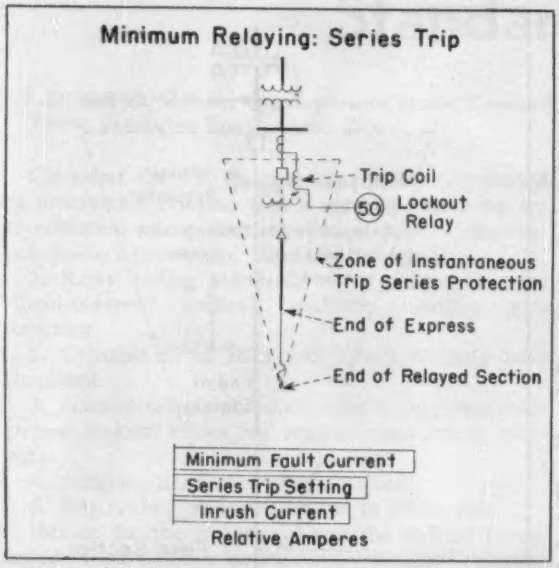


FIG 3—TYPE S FEEDER includes almost all power feeders. Series trip can be set at a point between the magnitudes of minimum fault current and the estimated inrush current

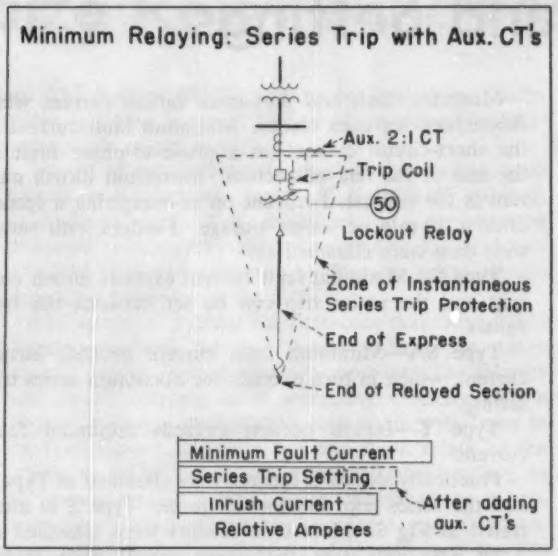


FIG 4—TYPE SA FEEDER covers most "light" feeders. With the addition of 2:1 auxiliary CT's, feeders classified as Type SA may be transformed effectively into Type S feeders

taneous setting is the estimate of the inrush current. Instantaneous unit setting should be at least 135% of inrush current. When this requirement conflicts with the instantaneous protection of the express against burndown, the latter criterion always takes precedence. On a few feeders with very long express sections, the instantaneous unit may trip on inrush. The feeder may then have to be sectionalized for load restoration after an outage.

All metal-clad switchgear is equipped with QTST. On new construction using old panels, it may not always be practicable to install the extra QT relays. The QT relay then is waived and relaying is reduced to the time-overcurrent relay and instantaneous attachment. Except for the lack of instantaneous protection for the No. 6 copper section, this scheme has the same performance as the QTST.

With instantaneous relaying always provided for the express, some margin of protection against wire burndown exists even with 8-cycle breakers. Performance would be improved greatly with faster breaker operating times. For this reason it is planned to install 2-cycle breakers on feeders with high fault currents in the express section. Use of 2-cycle breakers will improve the effectiveness of instantaneous relaying in the No. 2 and No. 6 copper sections.

Unattended Stations Have Lockout

Regardless of what type of phase-overcurrent relaying is used to trip the breaker, overcurrent lockout relays are on all feeders at unattended substations. The lockout relay is an instantaneous overcurrent relay which protects station equipment against reclosure onto severe faults. It operates on a close-in fault and prevents the breaker from reclosing.

For small rural substations, where interrupting duty does not exceed 6,000 amp, circuit reclosers are sometimes used. The recloser is set to cover the entire relayed section. Because of the usual light loading on rural substations, generally there will be no restoration trouble due to inrush. Even for higher inrush currents, the recloser may trip initially, but the subsequent time setting will allow it to ride through after reclosure.

Settings Also Standardized

Following these evaluations of relaying schemes, standardization of settings was studied. It was decided to select standard settings so that through their application the number of non-standard settings could be minimized. A feeder was classified as standard if it took a standard setting. Feeders are identified as standard by comparing their impedance with the equivalet impedance of the standard setting.

In series trip settings, the requirements of fault protection and inrush current result in two impedances which have to be considered. One is the total impedance to the compensation point, or Zcp. The other is the total impedance to the farthest point of the relayed section, or Zmax. If Zcp and Zmax are between specified limits, the feeder is standard. Otherwise, Zcp and Zmax are compared to another pair of limits derived from the standard setting for series trip with auxiliary 2:1 CT's.

For the QTST scheme, three impedances are required: Zcp, Zmax, and Zex, the last being the impedance to the end of the express. Zmax determines whether the time-delay unit will take the standard setting. Zcp and Zex together determine whether the instantaneous unit setting will be standard. Zcp and Zex are used in calculating inrush current and fault current at the end of express, respectively. This combination is the most variable circuit parameter. This is recognized in the standards by permitting variations in the instantaneous unit setting. The QT relay to cover the entire relayed section is given the same setting as the

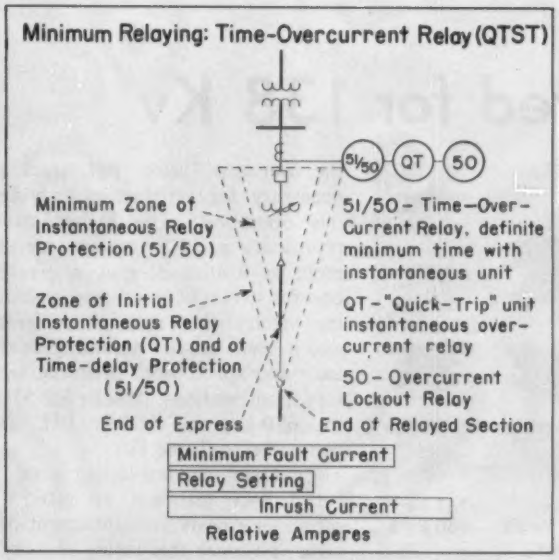

Minimum Relaying: Time-Overcurrent Relay (QTST)
51/50
QT
50
Minimum Zone of Instantaneous Relay Protection (51/50)
Zone of Initial Instantaneous Relay Protection (QT) and of Time-delay Protection (51/50)
51/50 - Time-Over-Current Relay, definite minimum time with instantaneous unit
QT - "Quick-Trip" unit instantaneous over-current relay
50 - Overcurrent Lockout Relay
End of Express
End of Relayed Section
Minimum Fault Current
Relay Setting
Inrush Current
Relative Amperes

FIG 5—TYPE T FEEDER requires a time-delay scheme in place of series trip to handle inrush current. Type T feeder may be transformed into Type SA during rebuilding program

time-delay unit. Standard settings are given in the accompanying table.

Before the reappraisal, the overcurrent lockout relay setting was calculated on the basis of faults in the underground cable part of the relayed section. However, an overcurrent relay cannot measure distance correctly and there are inherent inaccuracies in short-circuit calculations due to variations in impedance, especially of the feeder voltage regulator. Thus there were too many unnecessary lockouts on temporary faults in the overhead section. To reduce these, the lockout relay setting had to be raised.

The setting may be raised provided it does not exceed the minimum value of the safe withstand ratings of the various equipment. Examination revealed that the short-circuit rating of the feeder voltage regulator is the limiting factor. Thus, lockout relay settings were standardized at about the safe withstand value (25 times normal rating) of the regulator.

This simplified procedure eliminates the need for short-circuit calculations. It provides a standard setting for lockout relays applicable without exception to all feeders on unattended substations. In addition, operating personnel have positive information that, in event of a lockout relay operation, the magnitude of the short-circuit current is at least as high as the safe withstand value of the regulator. Such information will call for prudent judgment in restoring a feeder.

Standard setting for circuit reclosers is 200% of the normal feeder load, or 175% of the recloser rating, whichever is larger. The recloser is set for one instantaneous trip followed by three time-delay trips on a definite minimum time characteristic. The first reclosure has a 20-cycle delay, the next two a 5-sec delay each.

Simple Analysis Handles Unusual Feeders

To determine settings for non-standard feeders, fault currents and probable inrush currents must be determined. Fault currents are calculated for a phase-to-phase fault with arc resistance neglected. To simplify calculations, component impedances are added arithmetically and the fault current then may be read from a curve. Maximum inrush current is estimated by assuming a fictitious load impedance, called inrush impedance, at the compensation point. For a given feeder rating, inrush impedance is assumed to be constant.

Hence, the only variable is Zcp, the impedance to the compensation point. On this basis, inrush-current curves were plotted, giving the value of estimated maximum inrush in amperes versus impedance to the compensation point. These curves are illustrated. There is one inrush-current curve for each feeder rating. Once Zcp is calculated, the estimated inrush current may be read from the proper curve.

In determining impedances, either to a fault location or to the compensation point, voltage regulator impedance is considered. In an induction type regulator, impedance is minimum at either full-boost or full-buck position and maximum at either half-boost or half-buck position. With rated current the ratio of maximum to minimum impedance is about 3.5 to 1. Under high short circuits, however, because of saturation in the iron, the variation of impedance with rotor position is very much less. Because minimum conditions usually are desired for fault current calculations, maximum regulator impedance at rated current is used. On the other hand, in determining Zcp for inrush current considerations, minimum regulator impedance is used.

Standard Settings for QTST Relay Scheme

Feeder Rating	CT Ratio	QT and Time Overcurrent	Instantaneous	Z_{max} less than	Z_{cp} greater than	Z_{ex} less than
150 amp	30:1	300 amp, 1 sec.	900 amp, Inst.	3,620%	280%	1,210%
215 amp	60:1	480 amp, 1 sec.	1,200 amp, Inst.	2,260%	310%	905%
300 amp	60:1	600 amp, 1 sec.	1,500 amp, Inst.	1,810%	340%	725%
400 amp	80:1	800 amp, 1 sec.	2,000 amp, Inst.	1,360%	248%	544%

Z_{max} is maximum impedance to end of relayed section; Z_{cp} is impedance to the compensation point; Z_{ex} is impedance to the end of express.
All impedances are in per cent on a 4.6-kv, 100-mva base.

NEW DESIGN TREND

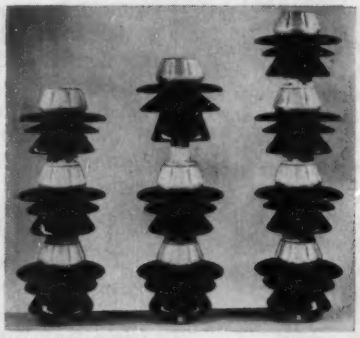
Insulator Stack Rated for 138 Kv

H. B. WEAVER, Insulator Department, General Electric Co, Baltimore, Md.

Stacking standard insulators for all 138-kv applications is a logical development in insulation for disconnect switches and bus-bar supports. A new combination of units in the stack gives utilities the advantage of inherent economies when impulse levels above 550-kv BIL are required and substation space is at a premium.

The combination consists of two NEMA TR 140 insulators with the new standard TR 53 unit on top. In both upright and underhung tests, it meets requirements for 138-kv use as listed in Table I. The combination may be substituted for the four-unit 161-kv stack on most 138-kv systems. With a weight reduction of 65 lb per stack, the new combination permits shorter switch bases and switch arms, lower clearances, smaller structures, and greater cantilever loadings.

Development of the new stack was prompted by rapid growth of 138-kv (nominal) systems. During 1948-54, 138-kv systems grew 385.3% on a circuit-mile basis, 115-kv systems 165%, and 161-kv systems 116.6%. Subsequently, manufacturers produced apparatus expressly suited for 132 to 140-kv systems, with porcelain bushings for



115 Kv 550 Kv BIL | 138 Kv 650 Kv BIL | 161 Kv 750 Kv BIL

138-kv. Equipment for 138-kv use has a 650-kv BIL.

The only exception has been the insulator stack for disconnects and bus supports. With the standard height increment for stacking insulators set at 14½ in., no combination of existing standard insulators was suitable for all 138-kv uses. Utilities with 138-kv systems could either under-insulate with respect to the rest of the system by using 550-kv BIL or over-insulate with 750-kv BIL insulator stacks.

Although companies with favorable operating conditions use the three-unit 550-kv BIL stack with excellent results, most believe that the four-unit 750-kv BIL stack is necessary for satisfactory continuous operation. The higher stack represents a 33% greater investment in insulators, plus a greater cost for switch blades, bases, operating mechanisms, and related gear, and it needs greater mounting clearance and space, both premium factors in substations. Stacks for 550-kv, 650-kv, and 750-kv BIL are compared in Table II.

First step in developing a stack for 138-kv use was an arbitrary rating as a basis for subsequent design. To meet this rating, either a new stacking insulator could be developed or a combination of existing standard insulators could be selected. Advent of the standard TR 53 insulator favored development of a stack by combining individual insulators produced by several manufacturers. Tests of combination's revealed that two TR 140 units with the TR 53 insulator best met the rating for 138-kv operation.

For high-strength applications, the bottom TR 140 unit may be replaced with a high-strength insulator which meets the same electrical ratings and has a 70% higher cantilever strength—2,500 lb upright and 2,100 lb underhung. Other mechanical ratings equal those of the standard insulator.

Table I—Rating Chosen for 138-Kv Insulator Stack

Height, in.	49
Arcing distance, in.	49¼
Leakage distance, in.	106
60-cps flashover, kv	
Dry	435
Wet	335
Impulse flashover, kv	
Positive	680
Negative	800
60-cps withstand, kv	
Dry	335
Wet	275
Impulse withstand, kv	650
RIV, μv at 1,000kc	200
Kv	88
Cantilever strength, lb	
Upright	1,350
Underhung	1,250
Tensile strength, lb	15,000
Torsion strength, in.-lb	20,000
Compression, lb	30,000

Table II—Insulator Stacks for 138-kv Applications

Units	Under-Insulated Three 14½ in.	Properly-Insulated One 20 in., two 14½ in.	Over-Insulated Four 14½ in.
Overall height, in.	43½	49	58
Arc distance, in.	44	49¼	58
Leakage distance, in	99	106	132
BIL, kv	550	650	750
Nominal voltage, kv (line to line)	115	138	161
NEMA Data*	TR 19 (Three TR 140)	TR 53 (one) TR 140 (two)	TR 25 (Four TR 140)

* NEMA publication SG-6 Power Switching Equipment, Par 6.02

NEW HOUSING in Los Angeles area spurs load growth

DISTRIBUTION TRENDS REPORT:

Keeping ahead of load growth makes Southern California Edison one of fastest-growing utilities

Now serving the electric power needs of some 4,200,000 people in ten southern and central California counties, Southern California Edison is one of the fastest-growing investor-owned electric utilities in the nation. In new meters added, it has topped all others for five of the last six years. Over the last decade, it has more than doubled its meters to a present total of almost 1,500,000. In fact, during the five years ending December 1956, its new meters were equivalent to the number required to serve a city of 800,000 population.

Initial cause of this growth has been the tremendous population influx into SCE's service area. But this in turn has touched off an even greater growth in commercial and light industrial loads. The distribution challenge facing SCE, therefore, has been to keep simultaneously ahead of a booming growth in three areas of load—residential, commercial and industrial.

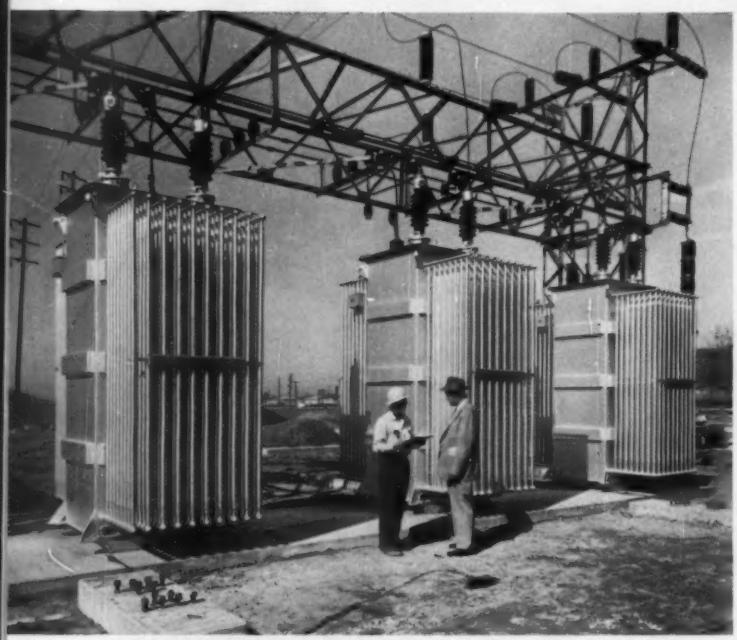
MORE POWER TO AMERICA

GENERAL ELECTRIC

Here's how General Electric helped SCE meet this challenge

DISTRIBUTION TRENDS REPORT:

Co-ordinated headquarters planning, based on "grass-roots" district recommendations, helps Southern California Edison prepare for mushrooming growth in all load areas



FASTER SYSTEM EXPANSION for SCE, through simplified purchasing and shorter deliveries, is permitted by repetitive-manufacture of G-E medium transformers. These in recently expanded Puente Substation, being discussed by G. Canfield (left) and W. I. Hartshorn, Foreman and Supervisor of SCE's Construction Dept., are three single-phase oil-insulated air-cooled units, rated 66 kv, 3333 kva.

The phenomenal load growth in Southern California Edison's service area is based on a variety of factors. Besides higher domestic consumption, they include increased industrial productivity, more shopping centers, offices, schools and hospitals, and more widespread use of improved lighting, air conditioning and electronic devices. The effect of these factors was reflected in 1956 kwhr sales when commercial sales were up 18.2%, domestic sales 13.5%, and industrial sales 11.1% over the previous year. To bring its long-range distribution planning into focus every year, SCE must know what and where the greatest anticipated growth will be, and for this it relies on "grass-roots" information from its 29 field districts.

HOW THE PLANNING WORKS—Each of SCE's districts has a distribution superintendent responsible for operation and planning, in addition to a commercial manager. The distribution superintendent continually makes long-range growth plans based on load studies and land developments. Once a year these plans are formalized into specific recommendations for new expenditures and installations keyed to growth areas. In this he works closely with the

SUSTAINED ACCURACY of G-E single-stator watthour meters is made possible by magnetic suspension feature which eliminates bearing wear. M. G. Spaller, Asst. District Supt. for SCE, observes installation by J. L. Mertel in new home.

REDUCED SYSTEM LOSSES and higher kilowatt loadings on feeders are obtained by SCE with this 225-kvar bank of open-rack pole-top G-E fixed capacitors. They also help maintain improved voltage levels by relieving generating and transmission facilities of the need for supplying the basic kvar load.

PLANNING CONFERENCE on distribution system expansion brings together (left to right) G. A. Davis, SCE Senior Planning Engineer; P. M. McCann, SCE Supt. of Distribution; W. T. Scott, G-E Sales Engineer; R. B. Kimball, G-E Electric Utilities Application Engr.; and E. H. Clark, SCE Asst. Chief Distr. Engr.

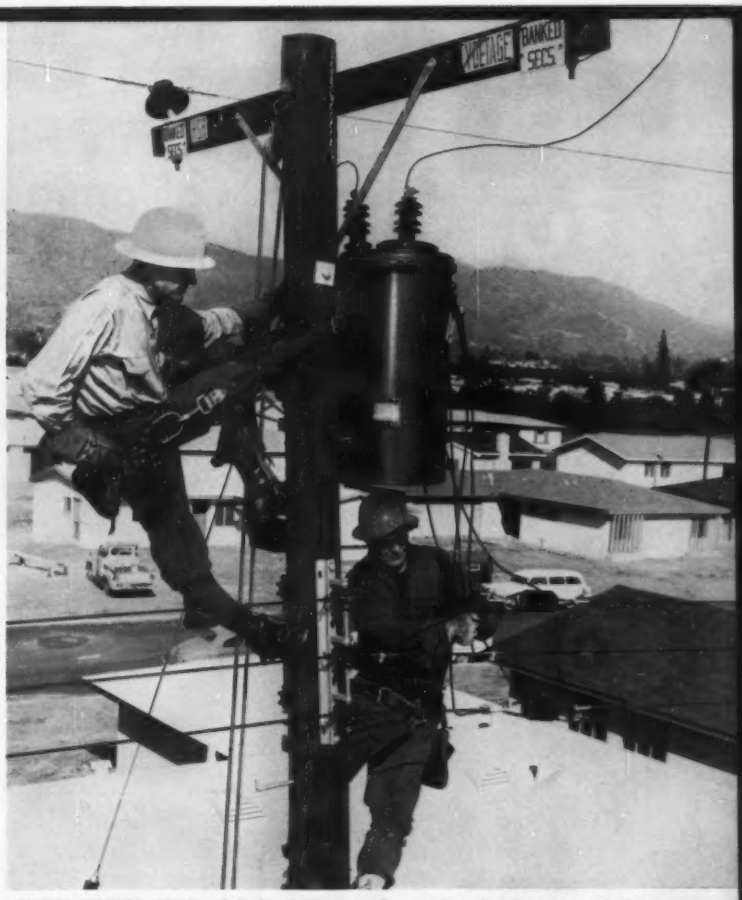
district commercial manager, who contributes information about the business and manufacturing expansion planned for the area within the next year.

MASTER PLAN PREPARED AND IMPLEMENTED—District recommendations are funneled to headquarters distribution engineering, where they are co-ordinated with the Company's overall generation and expansion plans. The final result is an integrated, master plan for expansion of the distribution system in the coming year. In implementing these plans, Southern California Edison has made extensive use of General Electric engineering assistance and equipment.

Working closely with SCE substation and protection engineers, General Electric application engineers provided engineering assistance in applying protective relaying equipment, regulators, and circuit breakers. In addition, General Electric engineers designed and applied a special ceramic bushing for capacitors to resist the area's severe atmospheric conditions.

When you specify General Electric, you take advantage of the latest advances in apparatus design, construction, application and the assistance of complete engineering services. To help utilities keep service running smoothly, highly trained General Electric service engineers plus a network of Service Shops stand ready to meet any and all maintenance and repair needs—day and night.

For full information on distribution equipment and Distribution System Services, contact your nearby General Electric Apparatus Sales Office, General Electric Company, Schenectady 5, N.Y.



LONGER SERVICE LIFE for G-E distribution transformers is aided by such exclusive features as one-piece stainless-steel clamping bands that result from continuing product development. Here, SCE linemen hook up a 15-kva pole-type G-E distribution transformer for residential service in a nearly completed housing development.

ADDED DEPENDABILITY of G-E distribution transformers stems in part from production-line impulse testing, most sensitive method known. These single-phase 100-kva G-E units are being connected to serve a large super-market in SCE service area.

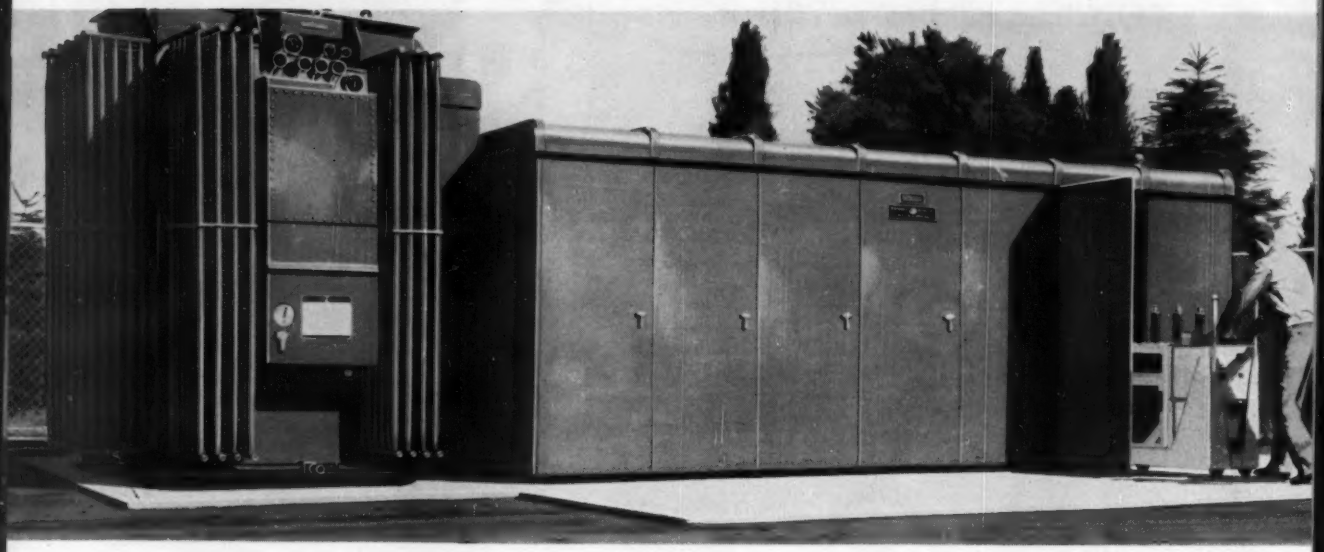
MORE POWER TO AMERICA

GENERAL ELECTRIC

Here's why it pays to see General Electric about your distribution problems

DISTRIBUTION TRENDS REPORT:

Southern California Edison is one of the major utilities using General Electric factory-built unit substations



HERE'S WHY:

Among the nation's major electric utilities, Southern California Edison is one of more than 100 that are saving time and money through reliance on General Electric factory-built unit substations.

These complete, ready-to-install substations are fully co-ordinated for dependable performance. With only one specification—one invoice—required, your purchasing is enormously simplified. There are no extras or accessories to buy, which makes the substation's low installed cost a realistic, predictable one. And because they are pre-engineered by General Electric, your engineers are relieved of many of the time-consuming technical details and made available for more productive work.

When you specify General Electric, you get the benefit of General Electric Distribution System Services which include extensive product development facilities—headquarters system planners—district application engineers and product specialists—equipment installation and field service engineering.

These services offer assurance of maximum operating continuity, on-the-spot application help, equipment efficiencies, valuable help in system design and techniques. Get the full story from your General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 303-5

LIVE BETTER ELECTRICALLY

MORE POWER TO AMERICA

GENERAL ELECTRIC

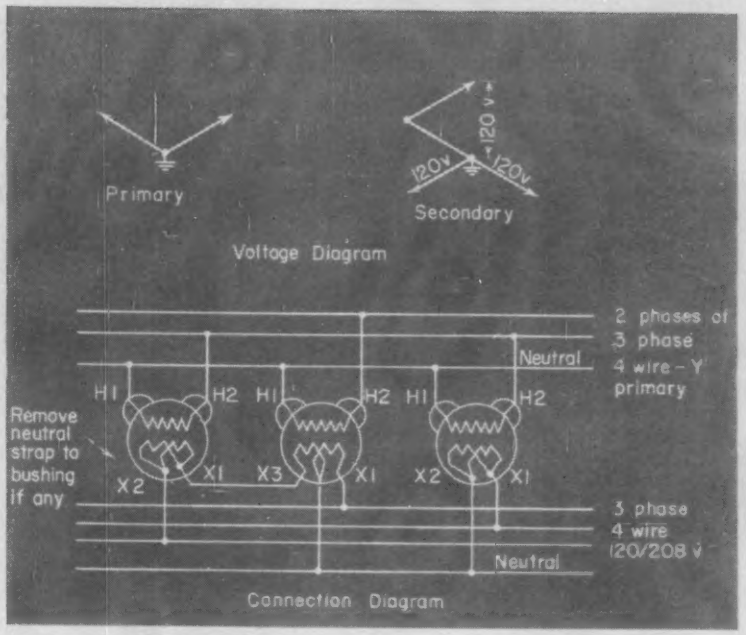
Two Phases Can Supply 4-wire 120/208 V

H. S. LEWIS, Chief Distributon Engineer, Central Vermont Service Corp, Rutland, Vt.

Two phases of a wye primary circuit can supply 4-wire 120/208-v service through the use of three transformers connected as in the diagram. Two transformers of normal size are connected for 120-v operation, and one of approximately twice normal size for 120/240-v.

Two phases of the secondary voltage are supplied directly from the two primary phases, and the third is the result of the open delta connection of the same two phases reversed in polarity. Voltage regulation of the indirectly derived third phase is greater than that of the other phases, but the unbalance is comparable to that on a standard open delta bank, which generally gives satisfactory results.

In recent years requests for 3-phase 120/208-v service for new school buildings and small industries have become more common in rural areas. Occasionally, an area's primary supply circuit is two phases of a 2.4/4.2 or 7.2/12.5-kv circuit. Accordingly, the cost of extending the third primary phase would be more than the additional revenue could support.



GENERATION—Construction

Man-Lift Speeds Construction Men to Job

F. A. WILLIAMSON, Project Supt, Plant Yates, Georgia Power Co, Newnan, Ga.

A conveyor type of man-lift speeds construction workers from one level to another at Georgia Power Co's Plant Yates. The man-lift saves about 7 min traveling between the basement and top level.

The easy-to-install man-lift is 122 ft high and has a 16-in. wide belt rated at 1,500 lb per in. width. Attached to the belt are steps and handles about 4½ ft apart, each step consisting of two small platforms with cross bracing between. Four rollers are attached to the corners of the platforms contacting the belt. These rubber-covered rollers ride in channel-iron guides, secured at the top and bottom of the man-lift and guyed to structural steel at other levels.

Belt Powered at Top

The belt is powered by a 5-hp gearhead motor at the top of the man-lift. Speed of the belt can be varied, but Georgia Power operates it at about 40 fpm.

A rope along one side of the man-lift is connected to the motor switch for starting and stopping the belt. As a safety feature, two switches near the top belt sheeve prevent a workman, who neglects to step off, from being carried over the top of the sheeve. These safety switches are operated by the rollers when a man is standing on the step and must be reset manually after opening the circuit.

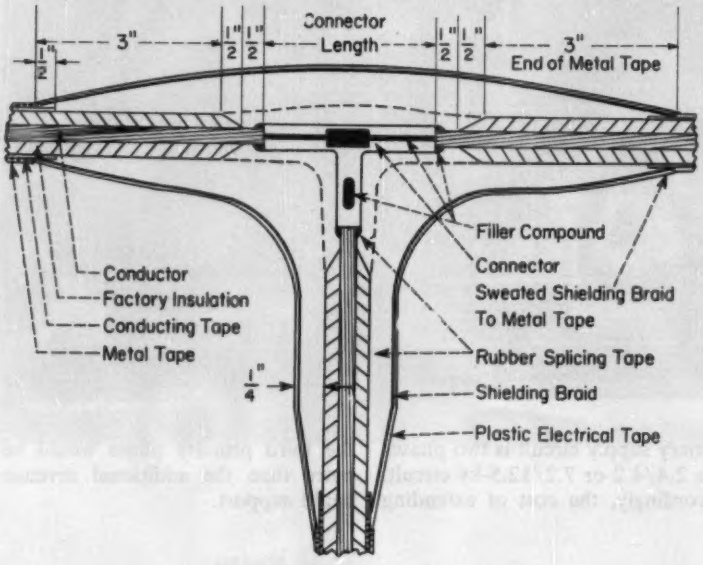
The man-lift is near the edge of the structural steel. To insure safe working conditions, a steel screen wall has been installed on the outer edge of the structure, from top to bottom, and the area around the man-lift at each level is enclosed by a hand rail, except for a 4-ft walkway opening.

Georgia Power first used the man-lift during construction of a unit at Plant Hammond two years ago. After that project was completed, the man-lift was disassembled.

Making Tee Joints on Aerial Cable

Procedures are indicated for making tee joints of both the shielded type and non-shielded type on 5-kv preassembled aerial cable. These are adapted from Distribution Standards of New England Electric System.

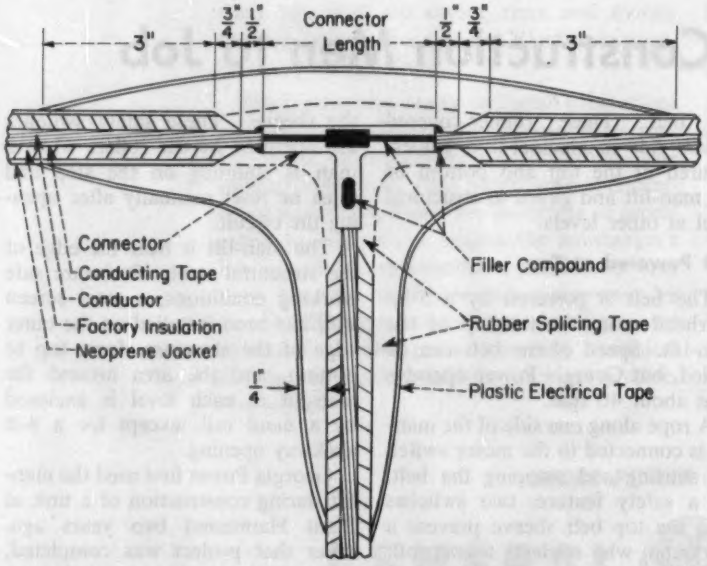
Procedure for Tee Joint for Shielded Type Cable–Copper and Aluminum Conductors



1. For Through Cable—Follow step by step procedure for straight joint (in shielded type cable) as outlined in the reference article*.

2. For Tap Cable—Follow procedure for type of cable used on the tap, that is, shielded or non-shielded, as outlined for the straight joint in the reference article*.

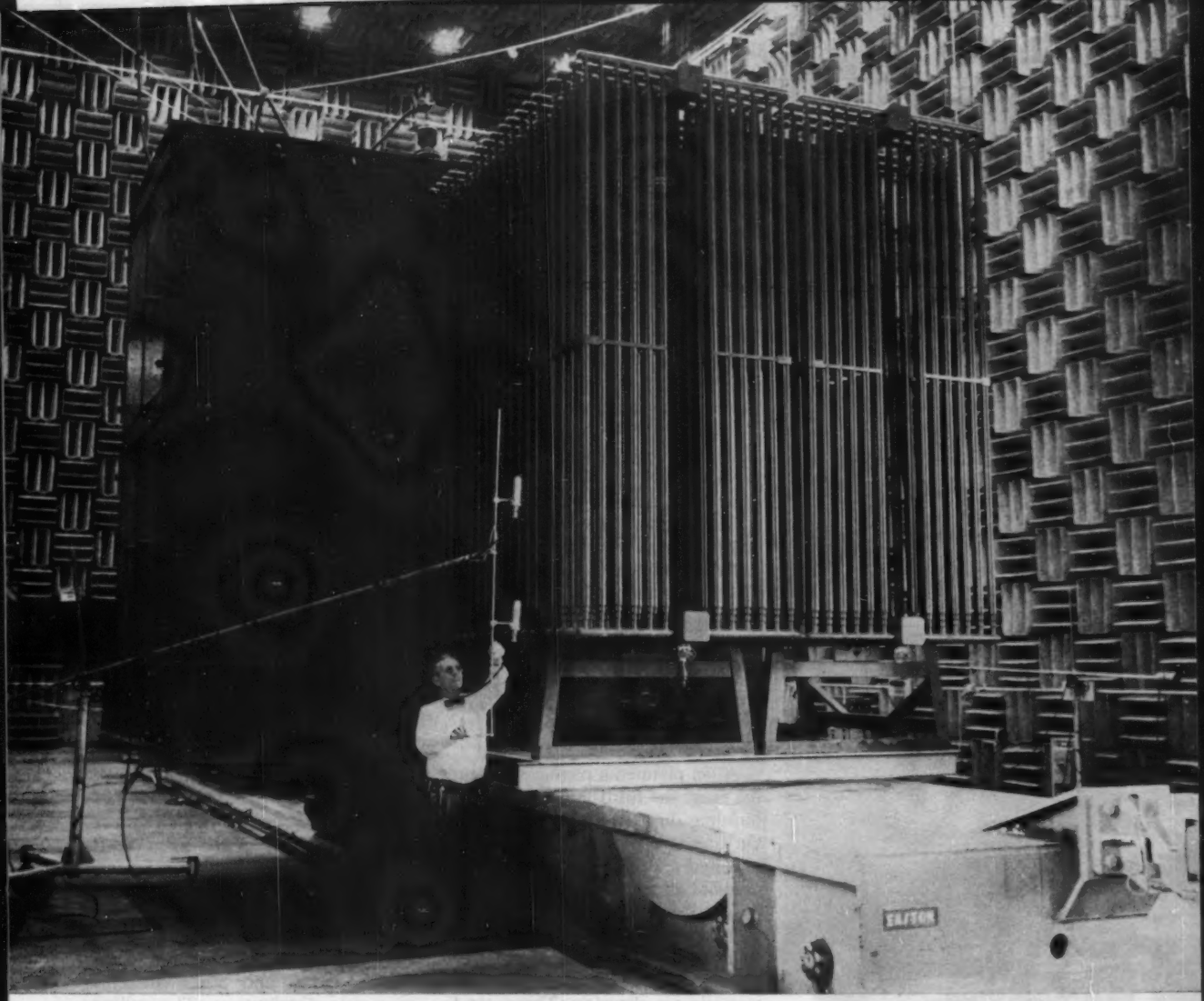
Procedure for Tee Joint for Non-Shielded Type Cable–Copper and Aluminum Conductors



1. For Through Cable—Follow step by step procedure for straight joint (in non-shielded type cable) as outlined in the reference article*.

2. For Tap Cable—Follow procedure for type of cable used on the tap, that is, shielded or non-shielded as outlined for the straight joint in the reference article*.

*Making Straight Joints on Aerial Cable: EW, Nov. 4, 1957, p 80



STEEL HOODS TRAP 15 TO 21 db

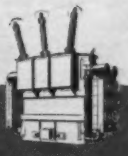
Here's a new method for combating transformer sound. General Electric's aphonic enclosures permit you to specify power transformers with 15- to 21-decibel reductions below NEMA levels. Costs are generally below those of other sound-reducing methods.

The enclosure, or hood, is fitted as an integral part of the main transformer to form a chamber which, combined with the use of noise-absorbing batts, effectively muffles sound. Flexible oil connections reduce noise transmission to the cooling equipment.

Additional benefits include:

- Sound is attenuated in all directions.
- Cooling efficiency is retained.
- Installation is simple because of factory assembly.
- Uprating a substation is not limited by permanent walls or barriers, since enclosure moves with transformer.

Power transformers with aphonic enclosures are available, with and without LTC and/or switchgear, in any size. Units rated 10, 25, 35, and 70 MVA are either completed or under construction. For details, contact your G-E Apparatus Sales Engineer. General Electric Co., Schenectady 5, N. Y. 421-51

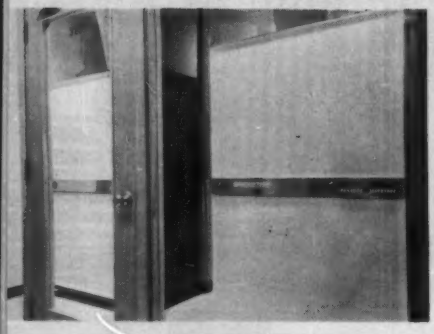


Power Transformer NEWS

Progress Is Our Most Important Product

GENERAL ELECTRIC

Utility Office Doubles as a Showcase



"How to Make Your Office Double as a Showcase—a Lesson in Merchandising" could be the title of this story.

Down in Texas, at Southwestern Public Service Co, they needed more office space at their Amarillo General Office. What they got was the extra space, an attractive showcase to merchandise everything from lamps to heat pumps, and a new employee lounge, to boot. Here's how it all came about:

Southwestern PS has an annual growth rate of 14%. With customers, records and services piling up at that rate, SPC had to look around for more office room. It found 8,200 sq ft of it in an adjacent garage. Primary responsibility for utilizing the space lay with vice president Hubert Allen.

Two Display Areas Used

Allen planned a passageway leading from the third floor of the main building directly to the new offices. On one side of this passageway he installed a display area for the appliances currently being promoted by Residential Sales. On the other side, brightly lighted and clearly visible through glass walls, stand four 5-ton heat pumps and two electrostatic air cleaners. These condition the air in the coffee shop and conference room-auditorium.

Each office area is decorated in a color matching one of the hues found in the multi-colored floor tile used throughout the addition. Different kinds of fluorescent lighting, depending on office size, are found here. Lighting intensity ranges from 45 to 75 f-c, depending on type of work being done in the area.

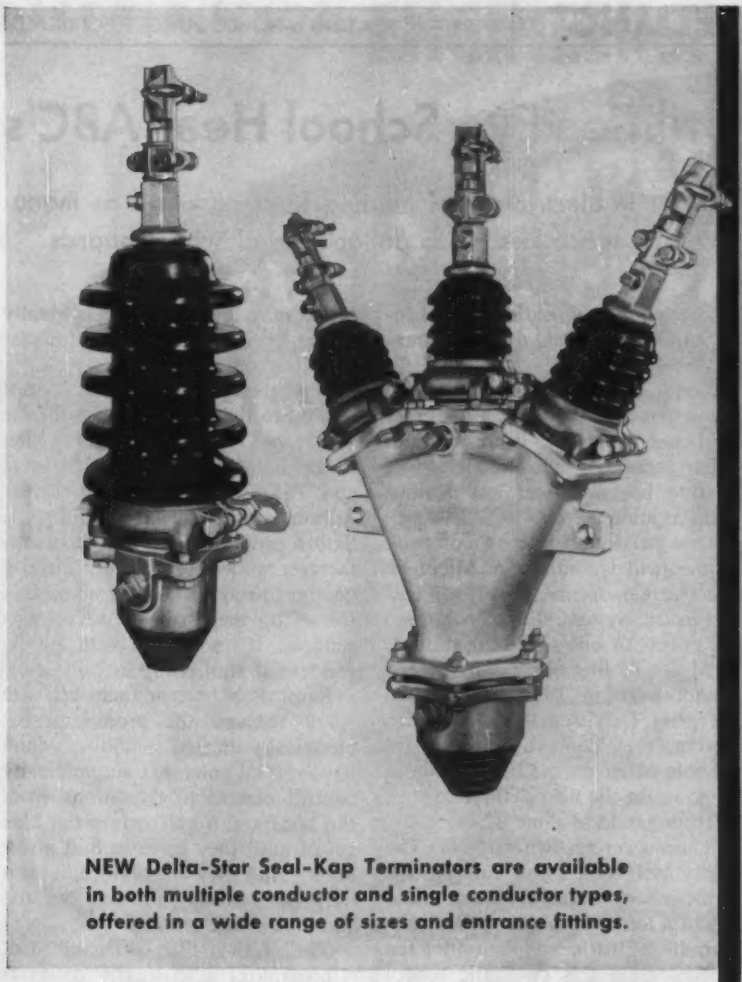
In one large office area used by the Panhandle Division's accounting department, all wiring for electrical, telephone and inter-communication systems is carried in underfloor duct work. Bench-marks visible in the tile locate the duct and points of easy access. That way desks and equipment can be moved without creating long spans of exposed electric and phone cords.

Coffee Lounge Softly Lighted

The coffe lounge is softly lighted by recessed and suspended decorative fixtures. A complete contrast from the high lighting levels of work areas helps make the coffee break restful and relaxing.

Electrical comfort and convenience keynote the 100-seat conference room. Paneled walls of semi-limed walnut in natural color are graced with translucent murals carrying surrealistic arrangements of electrical symbols. Full width drapes cover both ends of the 23 x 40-ft room. These drapes were custom-made using the silkscreen process. They carry through the electrical industry theme with pictures of the Public Service building, the company's plants, and other emblems of power distribution. The ceiling features wall-to-wall illumination.

Every sales story should stop with a sale—and this one does. E. Leo Miller and James Ramsay, partners in Miller Printing Co, were guests right after the opening of the coffee lounge and were taken on the tour of the new facilities. Result? Three 5-ton Weathertrons in their printing shop, plus a new lighting job.



NEW Delta-Star Seal-Kap Terminators are available in both multiple conductor and single conductor types, offered in a wide range of sizes and entrance fittings.

Cutaway of Seal-Kap Terminator conductor showing air-tight O-ring neoprene gasket at porcelain-to-metal joints.

Cutaway of Seal-Kap Terminator base showing pressure-tight seal, at metal-to-metal joints.

NEW, advanced line of DELTA-STAR *Permanently-Sealed* Terminators

The big feature of this new line of Delta-Star Seal-Kap Terminators is the permanent-seal construction—using pressure-tight O-ring neoprene gaskets at all joints. The terminator is permanently air-tight and moisture proof, with a partial vacuum created inside it.

Insulating oil and compound inside Seal-Kap Terminators cannot escape even when heating causes expansion. Many sealing arrangements are used on terminators, but none is more effective than the new Seal-Kap method.

Among other Seal-Kap advantages are economy in original cost—and economy through ease of installation and maintenance.

A range of sizes is available to meet most terminator applications—in both multiple and single conductor types. Get complete information—just ask for the new Seal-Kap catalog.

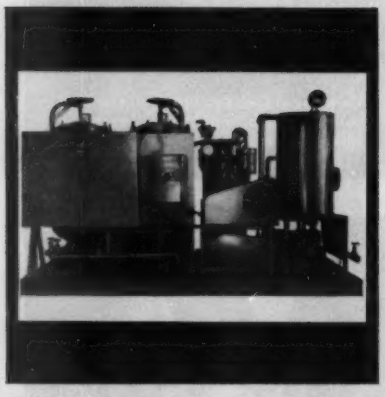
For your best *new* buy in terminators, call on *Delta-Star Electric Division, H. K. Porter Company, Inc., Chicago 12, Illinois. District offices in principal cities.*

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Porter Divisions: Cleveland, Connors Steel, Delta-Star Electric, Henry Disston, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan Crucible Steel, W-S Fittings, H. K. Porter Company (Canada) Ltd.

Here's proof that CFC PURIVAC restores Insulating Oil to "Like-New" condition . . .



Controlled laboratory analysis proves conclusively that the CFC Honan-Crane Purivac restores insulating oil to "like-new" condition:

	Untreated Oil	After PURIVAC Treatment
Neutralization Number	0.60	0.08
Dielectric Strength	22KV	35KV
Interfacial Tension (Dynes)	15	35
Color (NPA)	4½	2

Purivac purifies, dehydrates and degasifies insulating oil in one automatic operation. Purivac indefinitely extends the life of insulating oil in transformers, circuit breakers, oil-filled cables, and switch gear. Purivac operates in the field on energized equipment or at central reclaiming stations.

Eliminate costly transformer cleaning operations with Purivac — a complete system that has been proved *effective* in the laboratory and in the field.

COMMERCIAL FILTERS
CORPORATION
MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

Utilities Eye School Heat ABC's

Interest in electric school heating load perks up as manufacturers teach lessons to dollar-minded school boards

Electric school heating is awakening utility interest all over the country.

Long dismissed summarily by many power companies as impractical and expensive, it wasn't until a few years ago that electric school heating began to get any serious consideration.

One particularly active company in the field is Indiana & Michigan Electric Co. in the American Gas & Electric System. Largely through the efforts of one operating district, I&M got its first electrically heated school back in 1955 at Hartford City, Ind. (EW, Jan. 9, 1956, p 112). Today the company has eight schools either on the lines or about to go on in the near future.

How has I&M done it?

The answer has two parts: (1) The utility itself took a long careful look at the school heating load and found it had a lot of desirable characteristics; and (2) it has a lot to offer the customer (in this case, the school board) in first cost and operating savings.

Here's what sold the utility:

- It is a nighttime and early morning load (I&M regards it as off-peak).
- It doesn't aggravate the summer peak situation. Rather, it helps fill winter valleys.
- It has nice diversity. The schools, like distribution facilities, are spotted according to population.
- It has a unity power factor.
- It helps improve annual load factor.

For the customer, it offers:

- A savings in building cost by eliminating boilers and boiler rooms, flues, ductwork, piping, etc.
- A labor saving in reduced janitorial help.
- Operating cost savings, because units are energized only about 15% of the school day. Heat gain from lights, sun and pupils cut it down.
- Flexibility, in that rooms or areas may be heated individually without firing an entire central system.

But the new thinking is not limited to the midwest. The Pacific Northwest, long a stronghold of high residential consumption (1956 average: 7633 kwhr), has added electrically heated schools at a rapid pace. Said a prominent equipment manufacturer at a recent utility electric heating meeting, "One real market for us up there (the Northwest) is schools. It's a natural with all the residential stuff going in."

Several big manufacturers are solidly behind the promotion for electrically heated schools. Many have special units that automatically control classroom conditions from the hour and a half before the kids get in until they leave in mid afternoon. And they are performing not only the heating function, but the ventilating one as well.

The Edwin L. Wiegand Co. (Chromolox) is currently co-sponsoring a series of electric heat meetings with utilities for school boards, architects, consulting engineers and others interested. Says Wiegand's Sales manager Fred Kreiser, "We believe these meetings are of great value because they are telling an important story to people who are interested and in a position to improve the quality of our school plants.

H & C BRIEFS

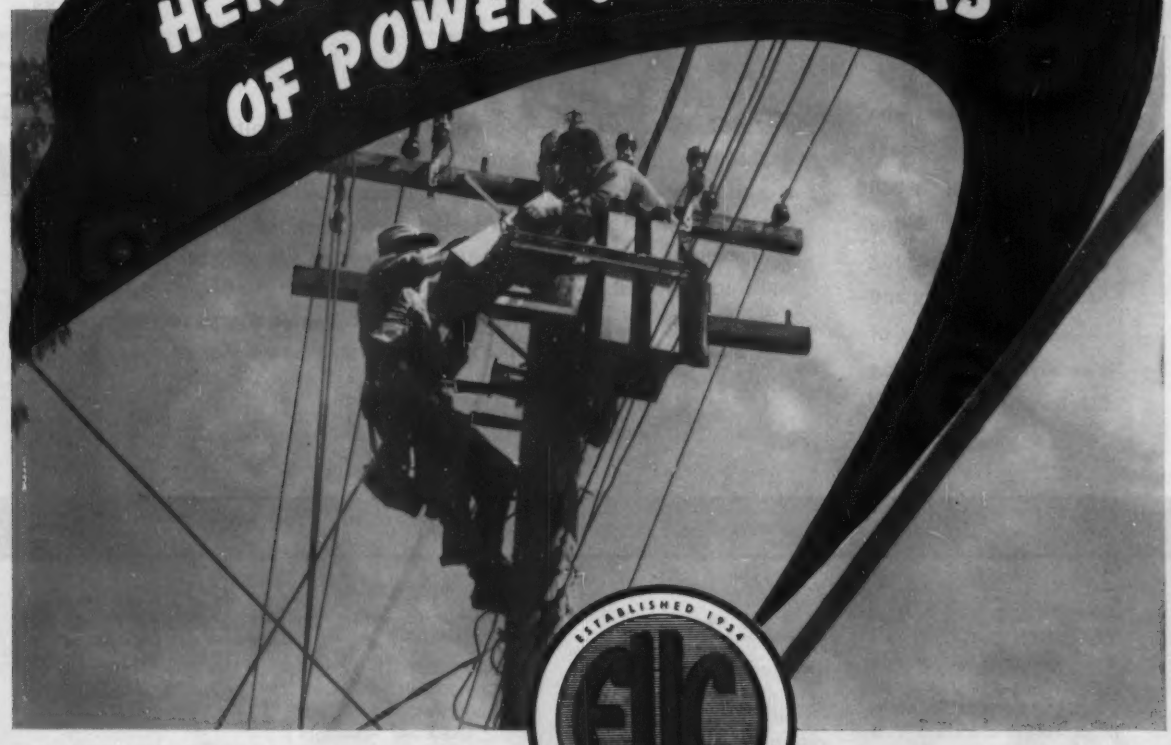
New Berko Load Control

Berko Electric Mfg Corp has come up with a new load control which it says cuts kw consumption by 75% by reducing voltage from 240 to 120 v during peak periods. It is designated PLC-4.

(*More Selling on page* 104)

DISTRIBUTION ENGINEERS:

HERE'S A COMPLETE LINE OF POWER CAPACITORS



ESTABLISHED 1934

EUC

Now available in all standard sizes including 50 KVAR units, EUC capacitors are thoroughly tested in the field over many years. They are already on the approved list of many power companies and in service on many utility lines.

- METICULOUS QUALITY CONTROL.
- DUST-FREE MANUFACTURING FACILITIES.
- SUPERIOR VACUUM IMPREGNATION.
- TEMPERATURE AND HUMIDITY CONTROL.
- 100% ELECTRICAL AND MECHANICAL TESTS (Exceeding Nema and AIEE requirements).
- 24 YEARS EXPERIENCE MANUFACTURING CAPACITORS.

Our new application manual and catalog is packed with facts about capacitors. Drop us a note and we will send you a copy.

Capacitors are our Main Line
Not a Sideline

★

ELECTRICAL UTILITIES CO.

LA SALLE • ILLINOIS

For The Ultimate in FLY ASH COLLECTION Be Sure It's...

WESTERN PRECIPITATION *First* in Electrical Precipitators

Power plant operators who want the finest equipment available for fly ash collection will find nothing to equal the long life, high efficiency and low maintenance of *Western Precipitation* Electrical Precipitators.

The reason is simple— No other electrical Precipitator is backed by so many years of leadership in the field—nor incorporates so many outstanding advantages pioneered by the industry's most experienced organization in the development of Cottrell equipment—experience beginning with the world's first commercial Cottrell installation!

This cross-section of a typical Western Precipitation Electrical Precipitator shows a few of the many important details that go into the construction of these units...

CONSTRUCTION FEATURES

▶ Arrangement of curtains (1), baffles and hi-voltage wires (2) assures optimum uniformity of electrical field—therefore maximum collection efficiency.

▶ Baffles (3) insure minimum dust reentrainment and optimum gas distribution.

▶ Curtains and hi-voltage system are engineered for maximum stability, even distribution of rapper impact, and unequalled ease of installation.

▶ No moving parts in the gas stream.

▶ Supports (4) for hi-voltage system are specially designed to resist side thrusts, and require minimum maintenance.

▶ Internal stiffeners permit clean, smooth external surfaces for easy insulation (5).

▶ Air-swept insulator compartments (6) insure long life, minimum maintenance.

▶ Unobstructed free-flowing hoppers (7) permit complete dust evacuation.

ADVANCED RAPPER DESIGN

▶ Frequency and intensity of rapping is variable over wide ranges to eliminate puffing and meet individual operating requirements.

▶ All rappers (8) are external for easy adjustment and maintenance.

▶ Flexible mounting—either side or top.

SAFETY ENGINEERED

▶ Hi-voltage insulators (9) are protected by separate compartments with individual access (10).

▶ Quick-opening access (11) doors are positive-sealing.

▶ Complete interlock system available at minimum cost.

"TRANSISTOMATIC" PRECIPITATOR CONTROL

▶ No tubes, no relays, no moving parts— *carries lifetime guarantee!*

▶ *Infinitely* variable precipitator voltage to suit operating conditions.

▶ Automatically compensates for line voltage fluctuations.

Before finalizing plans for installing any dust or fly ash collection equipment, get the full story on the finest collection equipment available—Western Precipitation Cottrells!

WESTERN PRECIPITATION CORPORATION

Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

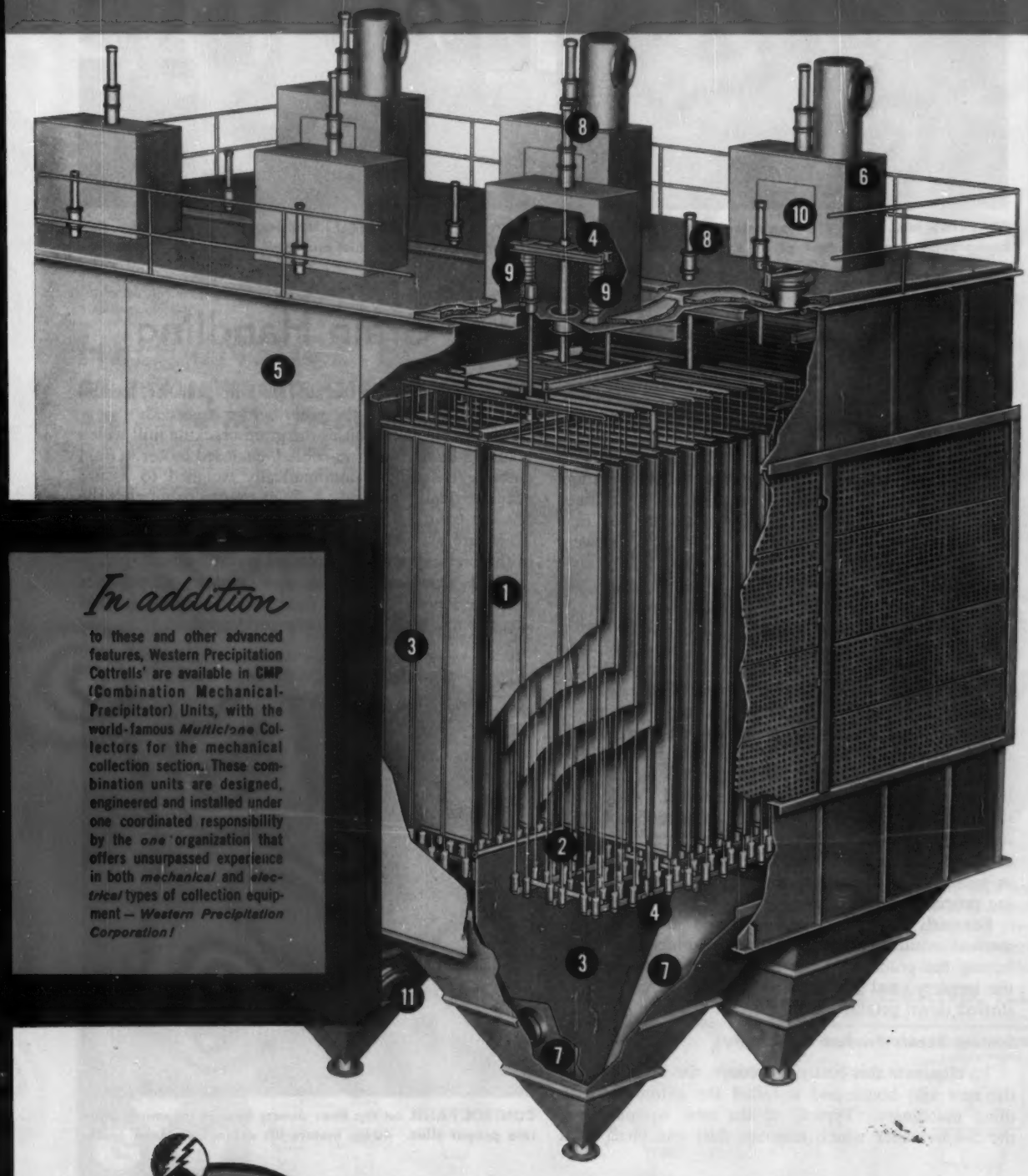
LOS ANGELES 54 • NEW YORK 17 • CHICAGO 2 • PITTSBURGH 22 • ATLANTA 5 • SAN FRANCISCO 4

Representatives in all principal cities

Precipitation Company of Canada Ltd., Dominion Square Bldg., Montreal

The only equipment backed by a

Half-Century of Cottrell Experience



In addition

to these and other advanced features, Western Precipitation Cottrells' are available in CMP (Combination Mechanical-Precipitator) Units, with the world-famous *Multiclone* Collectors for the mechanical collection section. These combination units are designed, engineered and installed under one coordinated responsibility by the *one* organization that offers unsurpassed experience in both *mechanical* and *electrical* types of collection equipment — *Western Precipitation Corporation!*

REMEMBER—*in the field of dust collection, nothing equals the long life, low maintenance and high collection efficiency of a Cottrell Electrical Precipitator!*

CRACKING MILL HAS 15-HP explosion-proof motor. Panel in background regulates flow of all the weighed ingredients

5-HP MOTORS DRIVE CLEANER (center) and polisher (left center) which remove dust and chaff, clean grain leaving silo

Automation Key to Brewery Grain Handling

EDWARD H. PECHAN, Power Sales Engineer, West Penn Power Co, Latrobe, Pa.

By converting its grain handling from a predominantly manual to a completely automated operation, Latrobe Brewing Co, Latrobe, Pa., has streamlined production, cut handling costs, and placed itself in a much better competitive position, according to brewery officials.

Blowers Store Bulk Grain In Silos

Now grain is bought in bulk, at a better price, and arrives at the door in tank trucks. 40-hp blowers lift the grain out of the trucks, force it into filters in the roof of a new, five-story silo house. From here the grain is transferred into the proper silo. The entire unloading operation is controlled from a panel board on the fifth floor.

Flow of grain ingredients from the silos to the brewing machines is automatically controlled. Automatic weighing machines draw the correct amount of each ingredient from the silos and measure each quantity accurately. The ingredients are then sent through one or more of the cleaning, polishing, cracking, and mixing processes on their way to the brewing vessels.

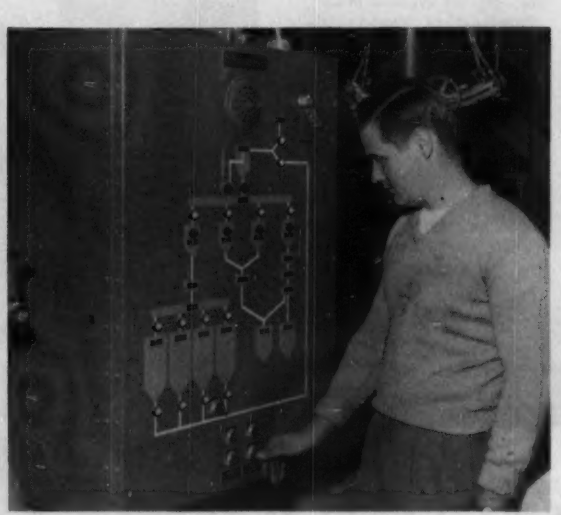
Formerly Latrobe bought its grain in sacks. This method required a great deal of manual labor for transferring the grain from rail car to truck, hauling it to the brewery, and placing it in storage. In addition, it slowed down production and raised handling costs.

System Boosts Product Uniformity

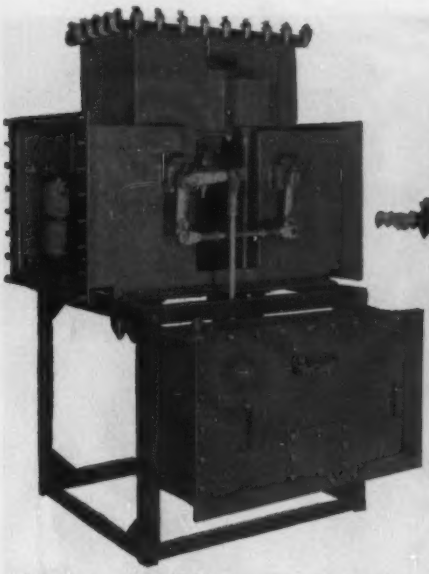
To eliminate this costly procedure, the brewery built the new silo house and installed the automatic handling machinery. Typical of the new equipment is the 5-hp cleaner which removes dust and chaff from the grain as it leaves the silo. A 5-hp polisher, located near the mill, cleans the grain before it is used.

The fourth floor houses the grain cracking mill which is driven by a 15-hp fan-cooled, enclosed motor. Grain entering the mill is automatically weighed to assure accurate quality control. A small control panel near the cracker controls the flow of the weighted ingredients. To assure maximum safety in the operation, all motors in the brewery are the explosion-proof type.

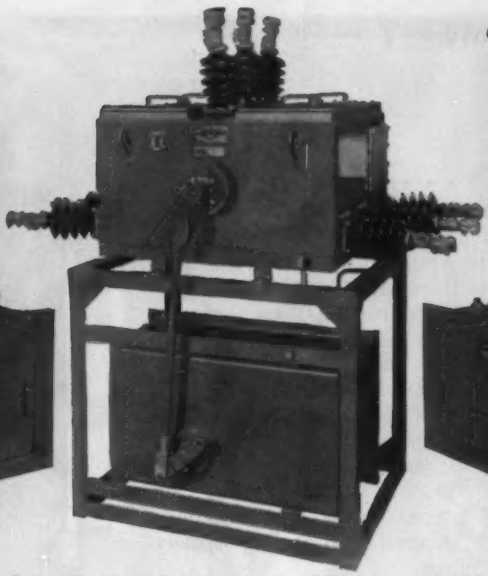
Final argument for the new system: it provides positive control over the final brewing results, makes it easier to obtain a uniformly good product.



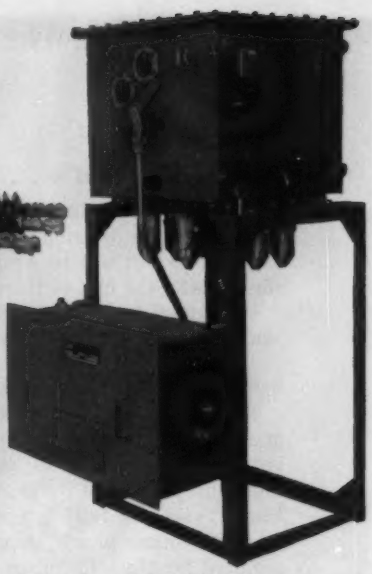
CONTROL PANEL on top floor directs flow of incoming grain into proper silos. 40-hp motors lift grain from tank trucks



Two single throw "RA"-5Kv. automatic transfer subway oil switch.



Double throw, overhead style, 15 Kv. automatic transfer oil switch.



Double throw, "RAD"-15Kv. automatic transfer subway oil switch.

HELP INSURE ELECTRIC SERVICE CONTINUITY

BY TRANSFERING IMPORTANT LOADS TO AN ALTERNATE FEEDER AUTOMATICALLY.

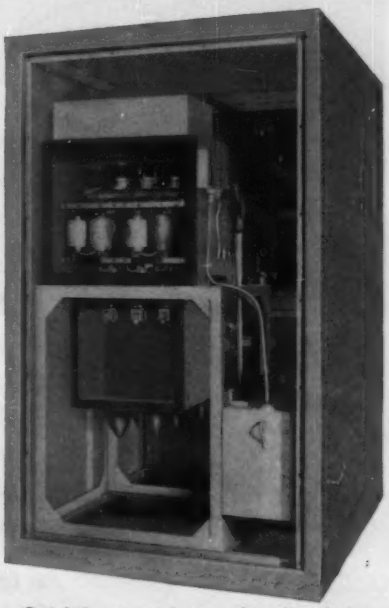
G & W Type "RA" oil switches with Model "F" operating mechanisms are furnished as practical, economical and remarkably trouble-free units for vault or overhead installations. The oil switch and mechanism case are of heavy welded steel construction, hermetically sealed. The oil switches may be double throw or two single throw units. Standard ratings—400 amperes, 5, 7.5 & 15 Kv. Special—1000 amperes & up to 34.5 Kv.

G & W automatic transfer oil switches have been giving satisfactory service since 1928.

What the Model "F" Mechanism does—

- When preferred feeder voltage fails, the load is automatically transferred to the emergency feeder.
- When preferred feeder voltage is restored (for a period of ¾ minute) the load is automatically returned to the preferred feeder.
- There is no "hunting" on system disturbances. Load cannot be thrown to a "dead" source.

- **Several standard and special control circuits are regularly furnished for varying requirements—for lock out in case of a short circuit on the load side—for remote operator selection of either feeder as the preferred—for automatic throwover and manual control of return.**



G & W automatic transfer oil switches are also available in UNICLAD metal enclosures to promote safety and present a neat and harmonious appearance in outdoor and indoor locations.

Send for series "DA" bulletin

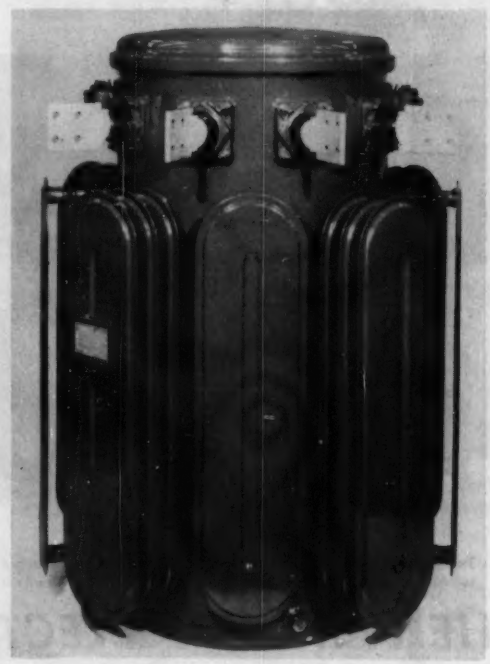
G & W ELECTRIC SPECIALTY CO. 3500 W. 127th St., BLUE ISLAND, ILL.

DA571 Representatives in many cities of U. S. A., N. & S. America Canadian Mfr. – Powerlite Devices, Ltd., Toronto, Montreal & Vancouver

High Voltage Cable Terminating, Sectionalizing, Protecting, and Connecting Devices

POTHEADS • BOXES • OIL FUSE CUTOUTS • LOAD BREAK OIL SWITCHES • SPLICING KITS

NEW EQUIPMENT



Transformers . . .

. . . have panel radiators of a new design. Pole-type and substation distribution transformers rated from 167 to 500 kva will be equipped with panel radiators shortly after the first of the year.

Panel units increase transformers' tank-wall strength, since there are fewer cuts in the tank. They are easier to clean and repaint, and require less space than the flat-tube or chimney-type radiators they replace.

Each panel is a sandwich of one flat piece of steel and one embossed piece, machine-welded around the edge. They are mounted concentrically on pole-type units and parallel to the sides of substation units. One header and one return pipe provide oil connections for one or more panels, depending on cooling capacity required for the transformer.

General Electric Co, Schenectady 5, N. Y.

Molded-Case Circuit Breaker . . .

. . . with continuous current ratings from 125 to 800 amp combines features of previous "L" and "M" frame breakers. "LM" type is interchangeable with either previous type. It may be used as panelboard main breaker, in power panels, switchboards, motor controls, bus-duct plugs, and individual enclosures. Pressure connectors are available for either single, double, or triple cable connections in each phase.

NEMA interrupting ratings are 50,000 amp, 240 v; 35,000 amp, 480 v; or 25,000 amp, 600 v ac; and 20,000 amp at 250 v dc. Continuous current ratings range from 125 to 800 amp.

I-T-E Circuit Breaker Co, Small Air Circuit Breaker Div, 19th & Hamilton Sts, Philadelphia 30, Pa.

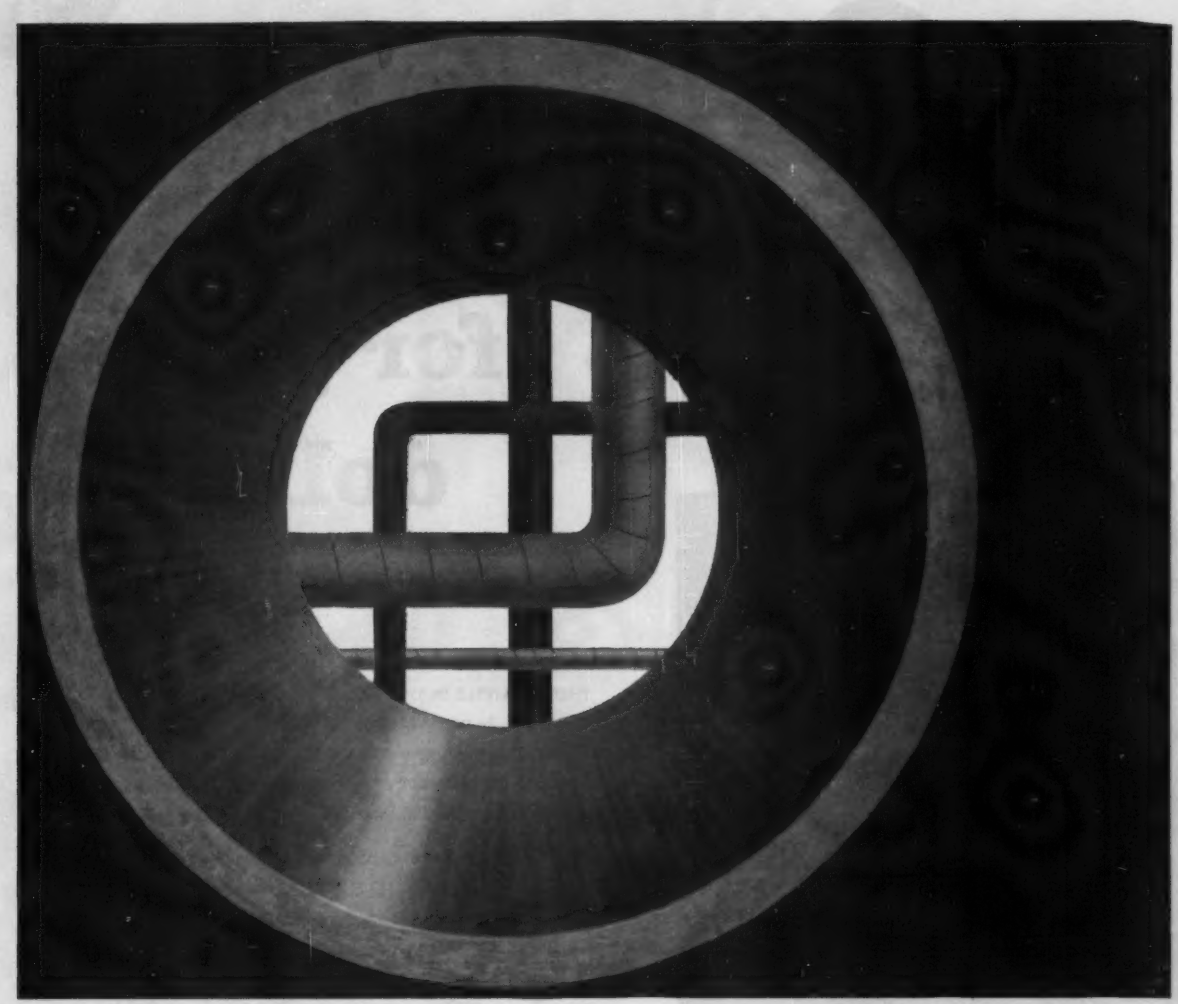
Conductor Clamp . . .

. . . is a high strength "dead-end" type. Keeper is not reversible. To facilitate installation keeper is "peened" to U-bolt. Pulling eye will accommodate the largest hooks.

Overall dimensions are approximately 4½x4½ in. Clamping range is from 0.160 to 0.522 in. Rated strength is 12,000 lb. The "DF-10" clamp is designed for use on ACSR ranging from 4 to 1/0 or copper from 6 to 4/0, as well as Copperweld and Amerduct.

Barron Bethea Co, Inc, Birmingham, Ala.

(*More New Equipment on page* 109)



Enjay Butyl—*today's super-rubber*
improves pipeline protection...cuts costs!

Plicoflex® Tape Coating, revolutionary new pipeline wrapping developed by Plicoflex, Inc., combines the outstanding protective properties of Enjay Butyl Rubber with the identification properties of a color-bearing plastic film to which the Butyl is laminated. Applied over an Enjay Butyl based primer and forming a permanent bond to the metal, the tape features: absolutely *no* moisture migration or penetration; exceptional resistance to shock-impact; excellent dielectric properties, and outstanding resistance to normal and unusual corrosive influences. This *cold-applied* wrapping is *safer* and *cheaper* to apply by hand or machine than hot coatings and requires fewer personnel.

This is still another in the steadily growing number of products developed with Enjay Butyl Rubber. Contact the Enjay Company for complete information about this truly *wonder* rubber . . . where it can help *you!* Complete laboratory facilities, fully staffed by trained technicians, are at your service.

ENJAY

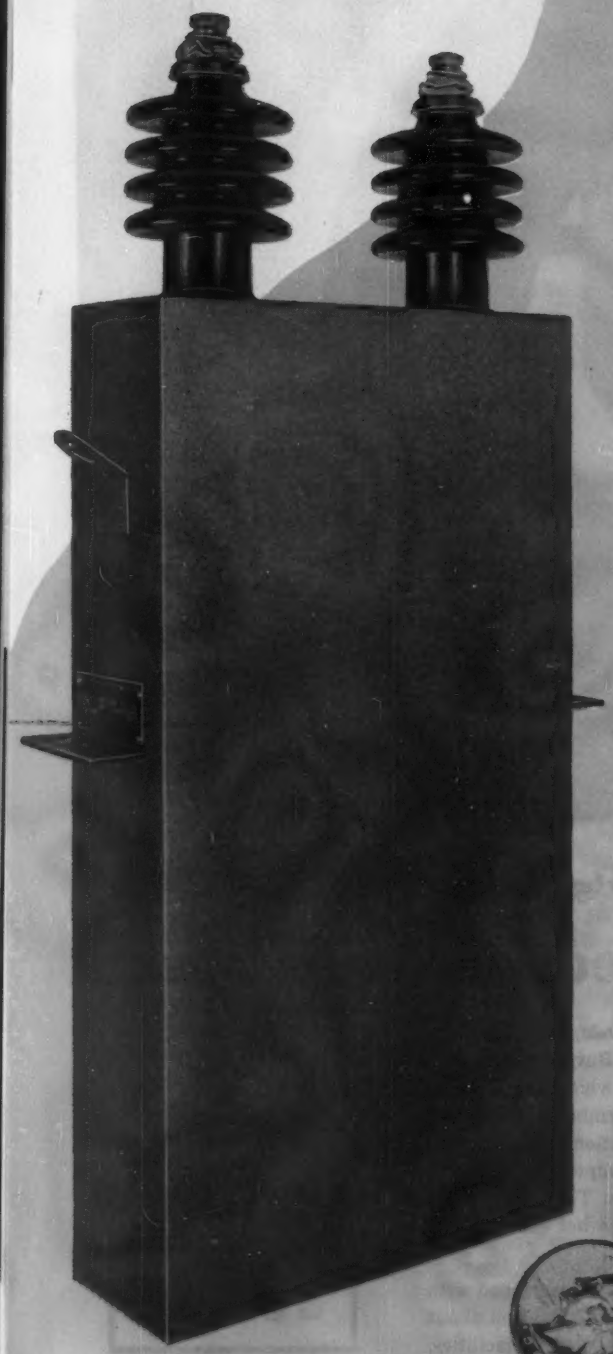
Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

ENJAY BUTYL

Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.



More capacitor for your dollar...

THERE IS LITTLE IN THIS WORLD YOU CAN'T GET "A LITTLE CHEAPER." In capacitors the cost of "a little cheaper" can be disastrously high—in maintenance and replacement. That's why C-D capacitors are built to stand up and last . . . have proven records of field performance extending over 20 years.

When you install C-D capacitors your savings are real and long range—because C-D builds into every capacitor longer trouble-free life. C-D capacitors can take the extra surge, the unexpected overload—because C-D capacitors have the "built-in extras"—because they're "Best by Field Test."

Insure low-maintenance service from your next power-factor capacitor installation, by talking it over first with a C-D engineer. Just write Cornell-Dubilier Electric Corporation, Dept. D-117, South Plainfield, New Jersey.

Here's why C-D Capacitors consistently exceed all field performance requirements:

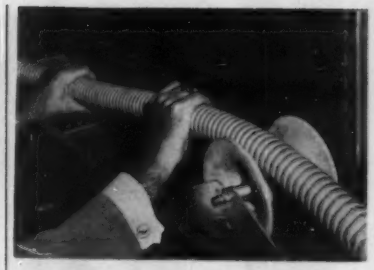
• Lowest dielectric unit stress and highest major insulation level. • Dykanol-filled bushings increase accepted flashover safety-factor, insure high level of impulse withstand. • Removable solderless connectors. • Many sections in series-parallel connection. Extremely low voltage gradient per section; less heating; no corona; longer life; lower power-factor. • Discharge resistor connected to each series section, instead of terminal to terminal. Provides effective discharge for each series group and balanced voltage distribution. • Side mounted lifting lugs—stronger and avoid risk of flashover. • Energization tested, 100 percent, to assure uniform distribution of low dielectric losses.

CORNELL-DUBILIER

consistently dependable

power-factor capacitors

SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER & CAMBRIDGE, MASS.; PROVIDENCE & HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD, FUQUAY SPRINGS & VARINA, N. C.; VENICE, CALIF.; & SUB.: THE RADIART CORP., CLEVELAND, OHIO; CORNELL-DUBILIER ELECTRIC INTERNATIONAL, N. Y.



Armored Cable . . .

. . . of interlocked type is easy to install, flexible, and takes up little space. Designed for power feeder systems in substations and industrial plants, the 600-v, 5-kv, and 15-kv cable is available with oil-base, butyl-base, or other rubber or thermoplastic insulation. Armor is galvanized steel, aluminum, or bronze.

Rome Cable Corp, Rome, N. Y.

Splicing Kit . . .

. . . insulates Y-splices by casting them in epoxy resin. Kit consists of a two-piece plastic mold which snaps together around the wire, two plastic spouts for pouring resin into the mold, sealing tape for mold joints, and a container of epoxy resin. Tap or branch splices can be encased in a block of insulating resin in less than 10 minutes. Applications include secondary utility circuits and lighting systems, underground or aerial. Kit will fit wires of ¼- to ⅝-in. outside diameter.

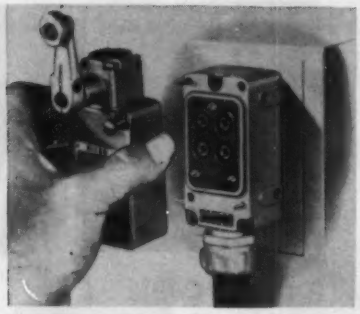
Dept D7-349, Minnesota Mining & Mfg Co, 900 Bush Ave, St. Paul 6, Minn.

Ultrasonic Cleaner . . .

. . . is portable, weighs 25 lb. Model DR 50-AH consists of a generator measuring 10x7x10½ in. and a transducerized tank, 9x5¾x5¾, with over ½ gallon cleaning capacity. Tank can be bench-recessed or flush-mounted. Unit has outlet tap for hookup with external recirculating filter or temperature control system. No limit timer is required. It operates on 115 v dc.

Acoustica Associates, Inc, 26 Windsor Ave, Mineola, N. Y.

(*More New Equipment on page* 110)



Limit Switch . . .

. . . can be replaced in seconds with no required adjustments. Switch enclosure including all moving mechanical and electrical parts plugs into separate terminal block enclosure containing wiring connections. To replace switching unit, loosen two screws, pull off switch, plug on replacement unit, and tighten the screws. Current-carrying spring plugs are integrally molded to switching element. Actuating arms may be pre-set to eliminate on-the-job adjustment.

Micro Switch Div, Minneapolis-Honeywell Regulator Co, Freeport, Ill.

Ultrasonic Generator . . .

. . . supplies 1 kw average power for 25-gal cleaning tank. Peak power is 4 kw. Vibration frequency is 28 kc. Measuring 25x17x19 in., the "Sonogen" model AP-200 generator weighs 175 lb.

Branson Ultrasonic Corp, 40 Brown House Rd, Stamford, Conn.

Radiant Heat & Light . . .

. . . in one package are provided by "Heat-N-Lite", a combination bathroom heater and light fixture. Quartz heating element has 91% radiant efficiency and is controlled by a thermostat. Light is on separate wall-switch. The all-chrome unit is 3½ in. deep.

Ampere Industries, 60 Boston St, Newark 3, N. J.

Control Cabinet . . .

. . . for inductor-type alternators is wall-mounted. Three-phase alternators from ¾ to 30 kva and single-phase units from ¾ to 15 kva are regulated by either electric or magnetic amplifier exciter-regulator. Input transformer permits regulator operations from line voltage. The 37x27x10-in. control cabinet also features motor start-stop push-button stations wired to control transformer with indicator lamp, to keep down regulator burn-outs. Available with two combinations of standard accessories.

American Electronics, Inc, 655 W. Washington Blvd, Los Angeles 15, Cal.

Portable Megohmmeter . . .

. . . measures 10-million megohms. Voltage on unknown is a regulated 500 v dc. Battery operated with a transistor power supply, it is suited for measuring leakage of transformers, motors, cables condensers, and insulating materials. Accuracy—±3% from 5 to 100,000 megohms; ±5% to 10-million megohms. Meter model No. is 2030.

Freed Transformer Co, Inc, 1783 Weirfield St, Brooklyn 27, N. Y.

Operations Recorder . . .

. . . for station and substation use automatically records all equipment operations sequentially on printed digital tape. The Millisecond Operations Recorder (MOR) helps to evaluate normal operations and to analyze upset conditions. The completely transistorized device can handle any number of inputs up to 400 points. It operates from regular station trouble contacts. Catalog 30A-1400 contains description and characteristics.

Fisher & Porter Co, 253 Jacksonville Rd, Hatboro, Pa.

More New Products

"Building block" system of mass-produced **metal cabinet enclosures** allows custom design of automatic control equipment.—Elgin Metalformers Corp, 630 Congdon Ave, Elgin, Ill.

Film printer duplicates microfilm negatives or positives at rates up to 2,000 cards per hour. Light source is an 800-w mercury vapor lamp.—Filmsort Div, Dexter Folder Co, Pearl River, N. Y.

All-purpose relay contains built-in re-set mechanism, can be set to close at any value of dc from 5 to 50μa, or comparable mv span of 10 to 100. It will handle 100 ma at 120 v ac without chatter.—Weston Electrical Instrument Corp, Newark, N. J.

Torque-measuring system for motor testing eliminates need for trunnion-mounted dynamometers. The digital system is available in eight capacities from 100 lb-in. to 3,000 lb-in. —Performance Measurements Co, 15301 W. McNichols Rd, Detroit 35, Mich.

Static detector pinpoints electric charge with no interruption of process flow. Measuring range of the hand-held device is 0 to 500,000 v. —United States Radium Corp, Morristown, N. J.

Solvent decomposes epoxides, polyesters, polysulfides, and silicone rubbers, allowing recovery of items embedded in casting resins.—Emerson & Cuming, Inc, 869 Washington St, Canton, Mass.

ELECTRICAL BUSINESS OUTLOOK

Electrical World
NOVEMBER 18, 1957

Here's the Latest Look . . .

. . . at electrical business for 1958. Electrical World presents here an up-to-the-minute forecast of utility kwhr sales for next year. And although the economic "breather" has been taken fully into account, 1958 still shapes up as a big year for the electric utility business.

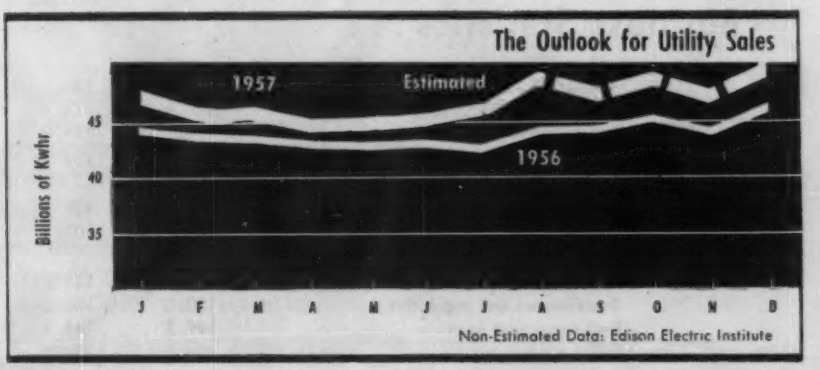
Industrial sales will climb 3.6%—to about 296 billion kwhr. With economists predicting a leveling-off or a slight drop in industrial production next year, it would appear that industrial sales of electricity would follow the same pattern. But this is not so. Automation makes the difference. Manufacturers are using more electric energy per unit of production; and with the pinch on profits calling for more economical operation, greater use of their automated production lines can be expected in '58. Under the worst conditions anticipated—a slight downturn—industrial sales will still beat the 3.5% climb registered in '57.

Commercial sales will rise 7.9%—to almost 103 billion kwhr. Commercial construction has been moving along this year, while residential building lagged. And next year's competitive marketplace will call forth more display lighting and an emphasis on the creature comforts supplied by electric heating and cooling. The swing to electric business machines for office work is adding load too, and will add more as the search for operating economies steps up in '58.

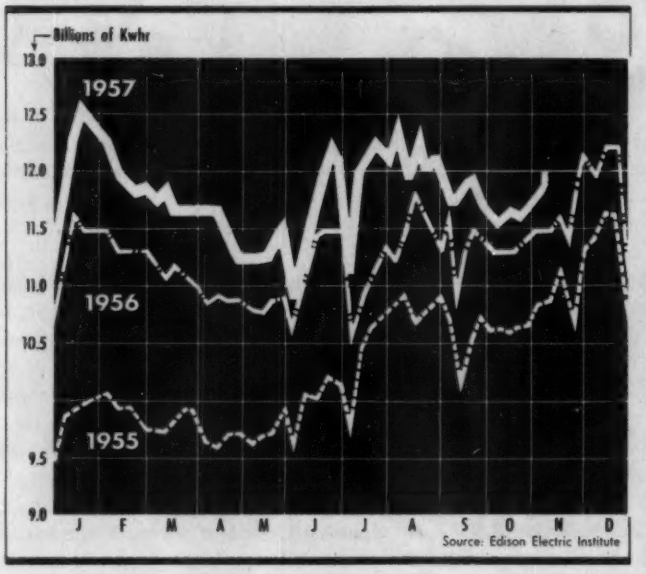
Residential sales will be up 10%—to 161.5 billion kwhr. The prime mover is more use per customer. In 1958 this residential average is expected to rise to 3,400 kwhr, for a 7% gain over this year. Expected increases in consumer disposable income should give the appliance market a lift, and a slight improvement in new home construction will round out the picture.

Sales to other customers will go up 4.5%—to 35 billion kwhr. Most important advances in this "catch-all" group are coming in rural electrification and in street and highway lighting.

This jacks total sales up by 6.1% to a record 595.2 billion kwhr. Percentage-wise, the increase trails 1955's 17% jump. But next year's sales will be running 114.3 billion kwhr ahead of the total sales during that boom year, and 34 billion kwhr ahead of this year. In short, 1958 will be the biggest year in history for electric utility sales—and by a pretty fair margin.



STATISTICS



OUTPUT

Week ended November 9, 11,914,000,000 Kwhr Up 3.4%

Per Cent Change From Previous Year

	Oct. 26	Nov. 2	Nov. 9
Total U. S.	+3.5	+3.2	+3.4
New Eng.	+1.8	+4.2	+2.6
Mid. Atlan.	+2.5	+1.7	+2.1
Cent. Ind.	+7.2	+2.5	+1.6
West Cent.	+5.3	+5.9	+5.9
Southeast	+4.5	+6.4	+4.0
South Cent.	+0.0	+4.4	+6.8
Rocky Mount.	+2.4	−1.1	+2.4
Pacific			
NW	+3.9	−3.5	+3.1
SW	+3.5	+4.5	+6.8

Seasonally Adjusted Index 227.9
Week Ago 226.8
Year Ago 219.7

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World estimate). Excluding AEC, output increase was 4.5%

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Aug.	125.75	124.99	118.01	6.6
Peak—Class 1 Systems.. million kw....	June	104.6	97.8	97.2	7.6
Estimated Dec. '57 Peak.	Aug.	113.0	113.2	114.6	−1.4
Production—billion kwhr	Aug.	55.45	54.35	52.19	6.2
Hydro		10.03	10.81	9.54	5.1
Fuel		45.42	43.54	42.66	6.5
Sales—billion kwhr	Aug.	49.79	48.09	46.24	7.7
Residential		13.05	12.59	11.60	12.5
Commercial		8.76	8.54	7.94	10.3
Industrial		25.06	24.07	23.93	4.7
Other		2.93	2.88	2.77	5.8
Fuel Consumption	Aug.				
Coal—million tons		13.33	12.72	13.18	1.1
Oil—million barrels		5.79	5.51	5.18	11.8
Gas—billion cu ft		160.96	158.91	142.04	13.3
Net Income Class A & B Co's $—million	Aug.	108.86	100.92	96.45	12.9
Residential Customers—millions	12 mos	46.49	46.35	45.25	2.7
Revenue per kwhr	ended	2.57¢	2.58¢	2.61¢	−1.5
Avg kwhr per customer	Aug. 31	3,104	3,082	2,915	6.5
Avg annual bill		$79.77	$79.52	$76.08	4.9

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	Sept.	146	144	146	n.c.
ENR Construction Cost	Nov.	154.6	154.7	147.6	4.7
BLS Cost-of-living	Sept.	121.1	121.0	117.1	3.4
New Orders for Machinery (1950 = 100)	Sept.	141	136	136	3.7
NEMA Sales					
Insulation materials	Aug.	134	127	153	−12.4
Electric appliances		86	101	100	−14.0
Wholesale prices	Sept.				
Motors and generators		142.4	142.6	136.2	4.6
Transformers and regulators		150.6	150.6	144.8	4.0
Switchgear and fuses		169.5	166.9	157.0	8.0
GNP—annual rate—$ billion	3rd qtr.	439.0	434.3	416.7	5.4

MANAGEMENT BULLETIN

FINANCE ▶ **Money market has been easing.** Utility liens have been under pressure. Government bonds are inching up with all issues yielding less than 4%. Interest rate on short-term treasury bonds have dropped below the discount rate. This is the first time in over two months. Business loans are definitely off. U. S. Government is planning to borrow about $11 billion. Just how the government will present this offering is not too clear as EW goes to press. Do not read into the changes in the money market a change in the Federal Reserve Board policy. It is still "sitting tight" although a little less so than a few months ago.

"A Statistical Review—1947-1956" has just been released by the Public Service Co of New Mexico. It contains a history, business and territory, depreciation, regulation, etc., of the company. For copy write: R. T. MacBain, secretary and treasurer, PS of New Mexico, Albuquerque, New Mexico.

A 34-story office building owned by the Kansas City Power & Light Co has been sold to Roger L. Stevens of Ann Arbor, Mich., and New York for $5,650,000. A down payment of $200,000 has been made with the balance to be paid between Jan. 15 and Feb. 15, 1958. The company has taken a 25-year lease on 14 floors and basement space. Pres Harry B. Munsell said the utility was getting out of the office building rental business at a time when the sale proceeds could be used to advantage. He referred to the tight money market and current high rates on financing.

RATES ▶ **Here is the latest rate picture.** Nova Scotia Light & Power Co will seek a rate increase next year . . . San Diego Gas & Electric Co is planning to ask for a rate hike . . . Fountain Electric Co, municipally-owned system, has been ordered to reduce its residential rates by 23.5%, commercial lighting 15%, school service 17%, and general power service 19% . . . Houston Lighting & Power Co is proposing to reduce the minimum rates charged to customers who have demand meters. The reduction will amount to about $50,000 a year, with most of the benefit going to small commercial users.

REGULATION ▶ **A fair return today for utilities should be in the area of 6½ to 7%,** Charles Tatham, manager of the utility department, Bache & Co, told the annual meeting of the New Jersey Utilities Association recently. He said utilities should earn this to cover the higher rates on borrowed money. With interest rates now around 5%, he pointed out, and common stock money risk capital costing considerably more, an overall rate of return of 6½ to 7% is needed to keep the utility companies in sound financial shape.

CONSTRUCTION ▶ **The first approved 1958 construction program** coming across our desk was submitted by Public Service Co of New Mexico. It totaled a record $11.5 million, an increase of about $3.3 million over the total provided for 1957.

EMPLOYEE RELATIONS ▶ **Recent wage settlements.** Missouri Power & Light Co has settled wage negotiations with two unions by granting a 6% wage hike . . . Luzerne Electric Division of United Gas Improvement Co and UWUA agree to a two-year contract with a wage increase of 5.75% granted on Oct. 1, 1957, and a 5.25% to go into effect on Oct. 1, 1958.

California's program to regulate health and welfare insurance has gotten underway with the appointment of a seven-member council to aid the state insurance commissioner in the surveillance of such funds.

A booklet on college recruiting has just been issued by the College Placement

Council on behalf of regional placement associations and by the U. S. Chamber of Commerce. It is titled "Principles and Practices of College Recruiting." For copy write: Education Department, USCofC, 1615 H. St, N. W., Washington 6, D. C., at 25¢ a copy or ten copies for $1.00.

A second summer student course was held at the Tanners Creek Plant of Indiana & Michigan Electric Co. There were 13 mechanical and electrical engineering students participating, all juniors and seniors from ten colleges in seven states.

Project ran from June 1 to August 30 under the supervision of college professors. Members of the engineering department of American Gas & Electric Service Corp and the Tanners Creek Plant provided the overall supervision of the project.

Purpose of the test project was to determine the condition of all major components of the plant, including tests on turbines, generators, and condensers, with a view toward finding areas of possible improvement in steam power generating efficiencies and economies.

OPERATIONS

A trend toward higher summer peak electric loads has developed for utilities operating in the Middle West and Northwest. This trend reflects the constantly growing demand for air conditioning and refrigeration generally. It has reached a point where some of these companies already show peak loads in summer months, much as many Southern and Southwestern utilities have experienced for several years.

This trend may have an important effect on maintenance expenditures. It has been the custom of many utilities to maintain major production units at seasons when they can be taken off the lines conveniently. Ordinarily this has been during the spring and summer. But flattening of the seasonal load curve reduces the time period within which this work can be accomplished. Consequently their expenditures for maintenance may be cut with a corresponding boost in earnings. On the other hand such a situation can lead to deferring essential maintenance, with consequent drop in future earnings.

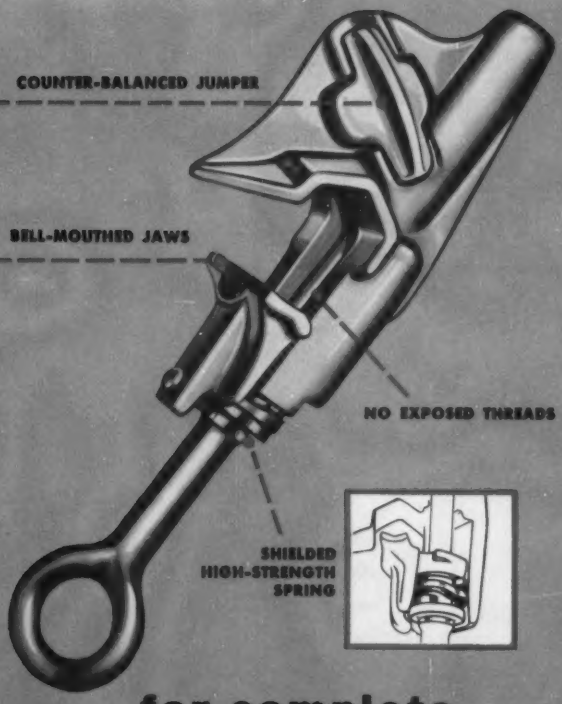
Already some utilities have tackled the problem with round-the-clock off-peak work, justifying the premium labor rate by savings in the high incremental cost of replacement power.

TAXATION

A Wyoming board of equalization ruling that municipally-owned electric utilities may be assessed and taxed will be appealed to district courts by some, if not all, 13 communities involved. Don Sherard, Wheatland city attorney and state legislator, said he was perfecting appeals for filing this week.

Nearly half the states have already, during 1957, raised the rates of one or more of the taxes levied by them (EW, 9/30, p 102). This adverse trend is confirmed by a more recent item, indicating that per capita state tax collections throughout the nation for the fiscal year ended June 30, 1957 (which is the same as the federal government's fiscal year) were 6% higher than in the previous fiscal year. This increase follows a more substantial rise in per capita taxes paid in the fiscal year ended June 30, 1956 over the previous year, bringing the total per capita increase in state taxes for the past two fiscal years up to around 20%.

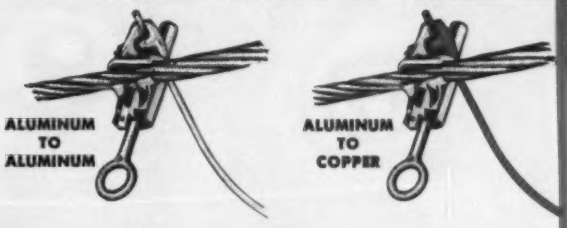
The states with exceptionally high per capita levies were Washington, California, and Louisiana. While these per capita figures apply primarily to levies affecting individuals, it cannot be doubted that the increases in corporate tax payments has kept pace with, if they did not exceed, the rise in taxes paid by individuals. This new evidence underscores the need to work continuously and aggressively with state legislatures and other authorities to limit further tax increases affecting electric utilities.



for complete

- **Conductor protection**
- **Contact protection**
- **Thread protection**

CHANCE PC CLAMPS



One AGP* Clamp can be used in all these combinations

Chance AGP Clamps, approved by power company after power company on the basis of their own tests, can be used for all types of connections: aluminum to aluminum, aluminum to copper, copper to aluminum, and copper to copper. They have the advantage of light weight which lengthens conductor life by minimizing the effects of vibration and makes them easy to handle with a clamp stick . . . plus easy identification by their distinctive appearance—plus their most important feature: Versatility. Available in both the "Protected Connection" and "Perma-Grip" types shown on this page.

***CHANCE Aluminum General Purpose-**

When specifying clamps or connectors choose the design that will

PROTECT Your CONDUCTOR!

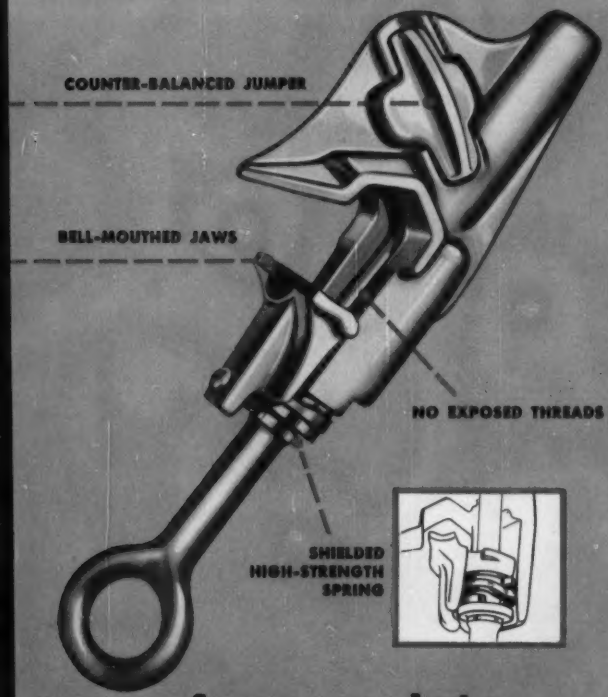
D. C. HUBBARD, Chief Engineer, Conductor Specialties, A. B. Chance Co., says: "In choosing clamps or connectors, remember that they can protect—or damage—the most important part of your circuit . . . the conductor.

"Our 25 years of continuous development and manufacture of clamps and connectors have proven that properly designed clamps should distribute current to each strand for surge protection. They should have adequate contact area and proper contour for cold flow protection. They should have sufficient conductivity for thermal protection. They should be designed to protect conductor against vibration fatigue.

"That's why Chance puts so much engineering into every tiny detail of clamp and connector design—to *protect your conductor.*"

Serving the Utility Industries since 1907

50TH ANNIVERSARY
A. B. CHANCE COMPANY



Chance PC (Protected C
offer extra protection for
clamp. The clamp is count
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This diagram shows the extra wide jaws that make contact with every outside conductor strand.

Clamp contact with every
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Chance PC Clamps are avai
sizes and types for every co

for complete

- Conductor protection
- Contact protection
- Thread protection

CHANCE PC CLAMPS

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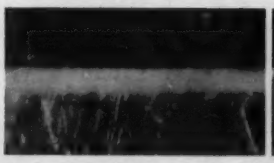

Micro-photo above compares Chan
(left) to commercial plating, one ro

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*CHANCE Aluminum General Purpose—Al to Al, Al to Cu, Cu

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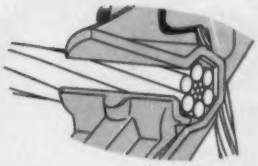

every outside conductor
surge protection, better
heating, less current loss
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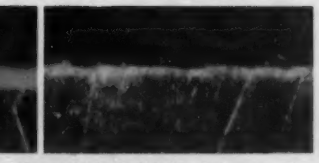


Chance AGP fortified cadmium coating
one reason for AGP's success.

admium coating, applied .001″
body of the clamp—plus zln—
ible resistance to corrosion and
of connections. This high den-
ium coating gives extra long life
clamp and the conductor.

Cu to Al, and Cu to Cu

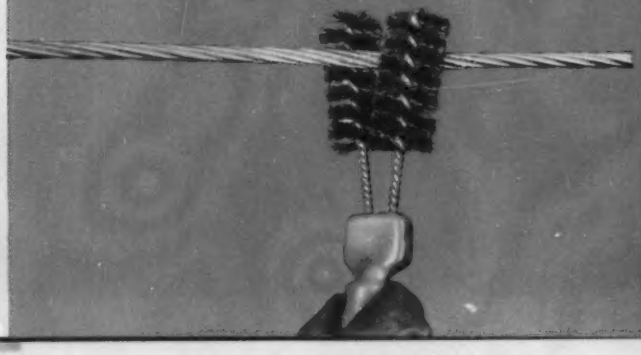
PERMA-GRIP the service-proved clamp for all general applications

Chance Perma-Grip Tap Clamps have been an industry standard for over 20 years. Perma-Grip Clamps make permanent or temporary connections that hold tight and stay put without vibrating loose. The gripping jaws make 3 point line contact with the conductor. The high pressure jumper contact has a long bearing surface that makes complete contact with all strands.

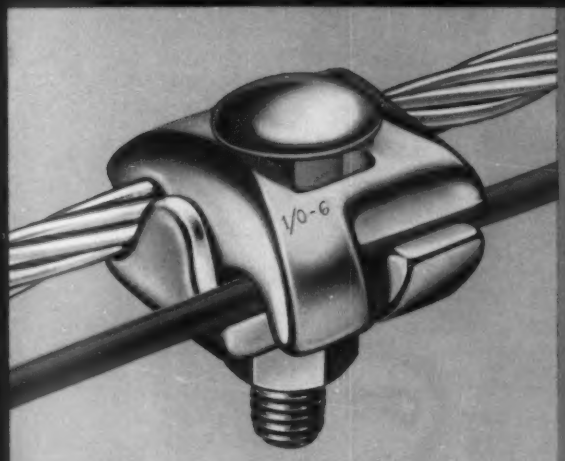
Perma-Grip Clamps are available in a full range of types and sizes to handle all conductors—with or without armor rods.

and . . . for longer lasting connections

DAVE HUBBARD recommends: "Remember to wire brush surface oxides off the conductor. Then apply a good corrosion-resistant compound to both the conductor and the contact surfaces of the clamp. You'll protect your conductor and clamps against corrosion and oxidation—add years of life to your connections and reduce costly maintenance. This is particularly important in combating crevice corrosion. Use Chance zln Electrical Contact Aid and conductor cleaning brushes for best results."



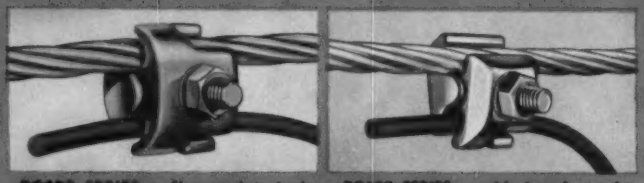
There's always a CHANCE for a better connection



PARALLEL GROOVE CLAMPS

These parallel groove clamps are designed for low cost, easy to install power line connections. Aluminum alloy body has high resiliency to keep connections tight under all load and temperature conditions. Available in two types: "AA", uncoated aluminum body . . . and "AGP" with fortified cadmium coating for all conductor combinations: and in

Your choice of two designs



PG200 SERIES . . . fingers interlock around main line and tap line.

PG100 SERIES . . . wide jaw for main line—interlocking fingers for tap line.

CHANCE PARALLEL GROOVE CLAMPS ARE ALSO AVAILABLE IN 2 AND 3 BOLT TYPES FOR EXTRA CAPACITY.

NEW

U-BOLT CONNECTORS

make tight, low resistance connections

These aluminum-bodied U-Bolts maintain good connections under varying operating loads and temperatures. Designed to prevent "bird-caging" under surge conditions. Available with 1 or 2 bolts. Aluminum or steel hardware.

NEW

CHANCE SPLIT-BOLTS

high conductivity plus strength

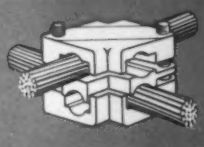
These newly-designed Chance connectors are forged from drawn copper, having the same characteristics as the conductor. These split-bolts stay tight longer because both clamp and conductor have the same coefficient of expansion.

NEW

UNICLAMPS

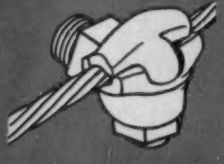
easy to apply—low cost

Now the popular Uniclamp is available with an aluminum body. "One piece" construction—can be installed without taking apart. Available in "AGP" for all connections and uncoated for aluminum connections. Four sizes fit all conductors up to 477 mcm. Uniclamps are also made with copper bodies for copper to copper.



MULTI-TAPS

For cross T, end to end, and parallel connections. Three sizes meet all requirements.



GROUNDING TERMINALS

High strength copper alloy connectors for grounding transformer tanks.

These connectors are part of the complete Chance line which offers a wide variety of clamps and connectors to meet every need. See your Chance Distributor, or write A. B. Chance Company, Centralia, Missouri, for full information.

CC57-3

A·B·CHANCE CO·

ABC INDUSTRIES

Electrical Insulating Materials Assn. Is Born

A better flow of practical information on insulating materials in the electrical and electronics industries is the goal of the new Electrical Insulating Materials Association.

On November 1, about 20 representatives of well-known insulating materials manufacturers met in New York City. The meeting was suggested by members of the Conference on Electrical Insulation of the National Research council and the Dielectrics Committee of AIEE.

Delegates Agree

During an all-day session, delegates tentatively agreed upon the following proposal:

"Electrical Insulating Materials Association (EIMA) is an organization sponsored by manufacturers for the benefit of all users of basic electrical insulating materials. EIMA is independent of any other existing technical society or trade association and is not intended to conflict with their objectives.

"This organization has been formed because of the recognized need for an improved method of communication between manufacturers of electrical insulation materials and the end users.

"Its function is the dissemination of technical, product and application information of all electric insulating materials used in the manufacture of electrical equipment. This will be carried out through the medium of national and/or local programs.

"Membership is not limited. The requirements for membership are that a company or individual be actively engaged in the development, manufacture or use of basic electrical insulating materials, electrical or electronic equipment.

"Membership is further extended to engineering and research personnel associated with the electrical industry, universities, and government agencies."

H. H. Chapman of Owens-Corning Fiberglas Corp was appointed chairman protem, and temporary committees on Organization, Publicity, Finance, Constitution, Programming, and membership were selected.

Meeting Is Planned

An industry-wide organizational meeting has been planned for Dec. 11 in New York City. Inquiries should be directed to H. H. Chapman, Jr, Manager Apparatus Insulation, Textile Products Div, Owens-Corning Fiberglas Corp, 598 Madison Ave, New York 22, N. Y.

Pole Line Hardware Subdivision Is Organized by NEMA

A Pole Line Hardware Subdivision has been formed by National Electrical Manufacturers Association, advised Joseph F. Miller, NEMA managing director. This subdivision is an organization of pole line hardware manufacturers. It follows discontinuance on Sept. 30 of the former Line Hardware Institute (EW, April 4, 1955, p 162).

Albert R. Waehner, director, Product Management, Line Material Industries, McGraw-Edison Co, Milwaukee, Wis., has been elected chairman of the Section; and E. R. McCoy, vice president, Joslyn Manufacturing & Supply Co, Chicago, is vice chairman. A. M. Salazar is recording secretary, located at NEMA headquarters. Former Institute Committees will carry on as NEMA committees through 1958.

Member companies of the Section are: A. B. Chance Co, Centralia, Mo.; Hubbard & Co, Pittsburgh, Pa.; Joslyn Mfg & Supply Co, Chicago, Ill.; Kortick Mfg Co, San Francisco, Calif.; Line Material Industries, McGraw-Edison Co, Milwaukee, Wis.; Malleable Iron Fittings Co, Branford, Conn.; Oliver Electrical Mfg Co, Battle Creek, Mich.; and Utilities Service Co, Allentown, Pa.

Product scope of this new NEMA section covers iron and steel products, known as overhead and underground hardware used in the construction and maintenance of electrical transmission, distribution and communication systems.

The NEMA section plans to expand its membership and to increase the effectiveness of its activities. These activities concern primarily cooperative efforts with the utility industry in developing product standards and in working toward the solution of various technical problems.

RT&E Builds in Oregon, Adds to Waukesha Plant

A fully integrated transformer manufacturing plant will be erected at Tigard (near Portland), Ore., by RT&E Corp of Waukesha, Wis. R. D. Nelson, company president, advised.

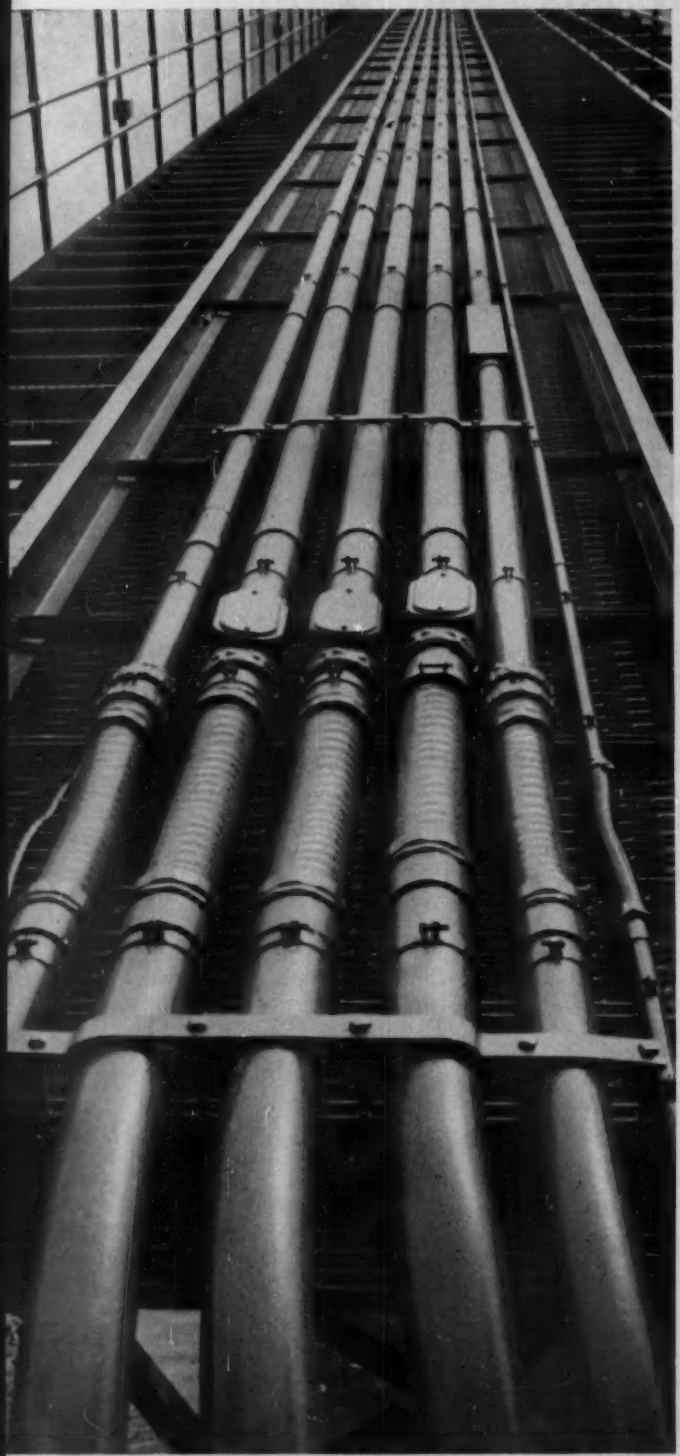
C. W. Shaw, vice president, will serve as general manager of the new plant. It will add another outlet to the present 12 warehouse branch distributing points.

Ground was broken late in October for a 23,000-sq ft one-level structure. The building is scheduled to be ready by May 1, 1958.

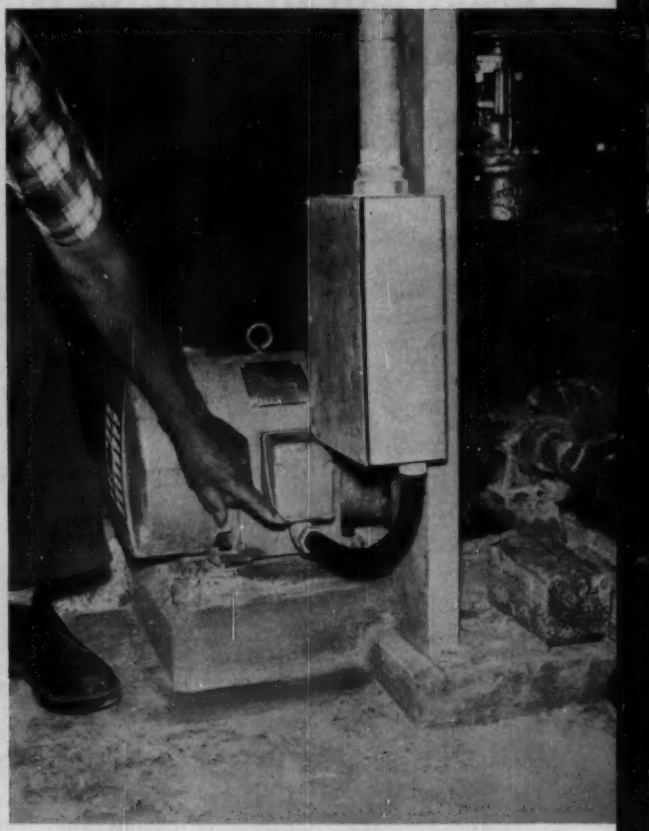
At the same time an addition is being made at Waukesha. This new unit will have 11,000 sq ft for manufacturing and 4,000 sq ft for office area. It should go into production in December.

(*More M&M on page* 122)

How 3 utilities save time and money



Three- and four-inch Sealtite at Con Edison's Astoria, N. Y., plant take up expansion of conduits carrying heavy power cables on outdoor coal conveyor. Sealtite absorbs vibration when coal is hauled up--resists weather, salt spray from river, coal dust.



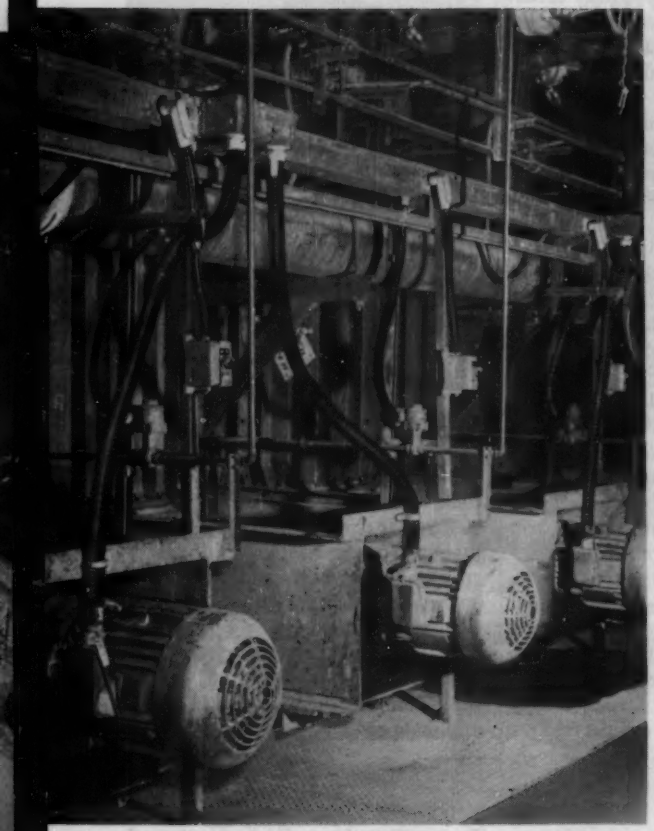
Oil, dust and dirt cover Sealtite on this motor connection in Florida Power & Light plant. Still no trouble. Waste was eliminated by cutting Sealtite on the job.

From outdoor coal conveyor to indoor recirculation motor—Sealtite* flexible, liquid-tight electrical conduit more than pays for itself. That's the experience of Con Edison, Florida Power & Light, and Wisconsin Power & Light Co.

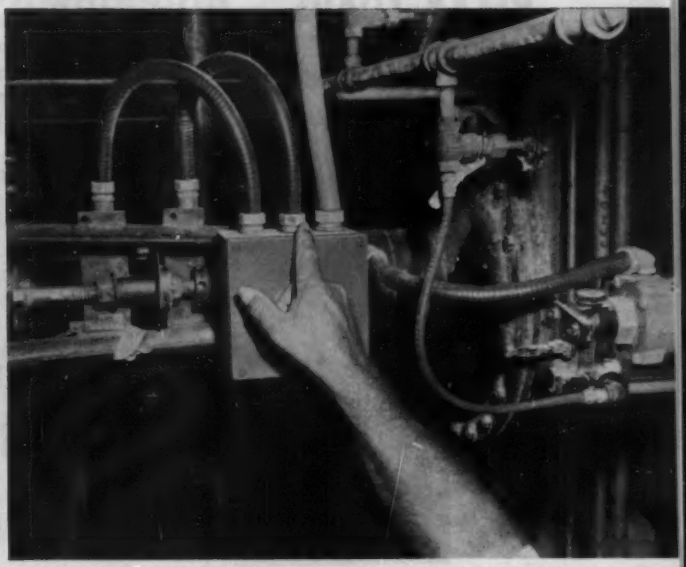
Sealtite is installed in far less time than it takes to bend and fit rigid conduit. Yet it *outlasts metal conduit!* Sealtite conduit takes up movement, vibration . . . resists heat, moisture and dirt . . . simplifies replacement of parts. Tough vinyl jacket on Sealtite gives wires lasting protection!

Where to get Sealtite – Electrical Wholesalers stock Types U.A. and E.F.† Sealtite in easy-to-handle cartons or on reels, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite." Buy it in long lengths and cut it on the job without waste. Special liquid-tight connectors are

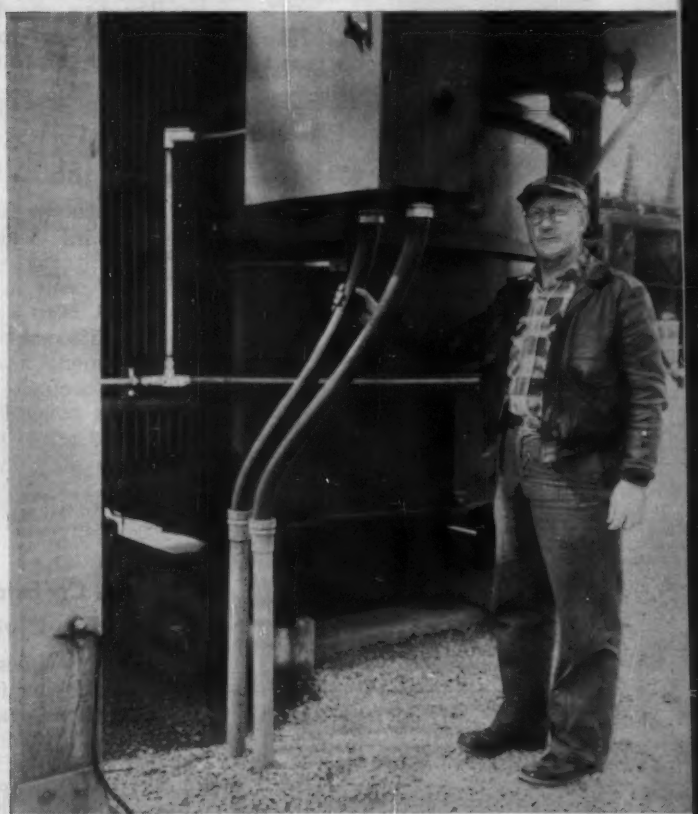
with Sealtite flexible, liquid-tight conduit



Six-inch rise and fall of boilers takes place as they heat and cool in Con Edison plant. 1½-inch and ¾-inch Sealtite take up this movement, resist heat, moisture and dust.



Sealtite speeded original installation . . . will simplify replacement of parts later on one of the recirculation valves at Florida Power & Light plant, Dania, Fla.



Termination of underground duct at transformer was simplified at Wisconsin Power & Light Co., Janesville, Wis., substation with 3-foot runs of 2-inch Sealtite. Sealtite will not rust or corrode.

available from leading connector manufacturers. Free Booklet S-538 gives full information on Sealtite. Write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association.

*Trademark †Pat. Applied For 57190

Insist on the conduit marked

SEALTITE*

flexible, liquid-tight conduit

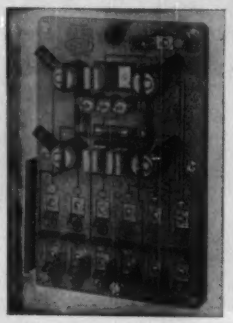
an ANACONDA® product

TEST JACKS
QUICK CONTACTORS
RELAY LOADS

EXCLUSIVE STATES FEATURES

POLYPHASE METER TEST JACK

(Cat. No. 99121)



Will accommodate standard 3-element self-contained, 2-element, 3 ph., 4 wire Delta self-contained; 2½ element, 3 ph., 4 wire WYE self-contained; and 3-element 3 ph., 4 wire Delta self-contained meters.

Now available: Test Jacks for other Polyphase Meters!

200 AMPERE QUICK CONTACTOR

(Cat. No. 99209-B)

Simply swing lever in one direction to open all blades simultaneously; slide in meter and swing lever in opposite direction to make positive contact. 200 amperes capacity.

RELAY LOADS

Ohm-spun RESISTORS

- Non-inductive resistance.
- Smooth adjustment from .05 amperes to full capacity of the load.
- Loads are made in different capacities: 30 amperes, 25/50 amperes and 60 amperes.
- Light in weight, yet ruggedly constructed.
- All units self-ventilated.

THE STATES COMPANY
19 New Park Ave., Hartford, Conn.

Please send me information on
☐ Test Jacks ☐ Quick Contactors ☐ Resistance Loads

Name .....Title .....

Company .....

Address .....

City .....Zone....State.....

I-T-E to Market New Line of Breakers and Switchgear

Low-voltage power circuit breakers and the switchgear that makes use of them form a product line ready to be introduced by the Switchgear Division of I-T-E Circuit Breaker Co, Philadelphia, Pa.

Results of this completely redesigned line is in terms of improved performance, simplified operation and servicing, also standardization in construction and assembly.

The new K-line circuit breakers are 600-v units in 225-, 600-, and 1600-amp frame sizes. They are reported to be as much as one-third smaller and 55% lighter. Six subassemblies take the place of the 130 separate major parts in previous models. Reduction in breaker size permits four-high stacking of 600-amp breakers in standard 90-in. high-enclosures. Only nine trip units are required, compared to 23 used in the previous line. The breakers have quick-make manual closure and will trip while being closed if short-circuit fault occurs.

The new switchgear introduces closed-door draw-out for the breakers. With this feature the breakers

can be moved from operating to test-and-disconnect positions within their enclosure without opening switchgear cabinet doors (see picture). Standardization of breaker and cradle assembly and switchgear enclosure simplifies interchange of various size breakers.

The breakers and switchgear are designed for power station, industrial plant and commercial building applications.

Westinghouse Ups Wages

Westinghouse Electric Corp and International Union of Electric Workers agreed to a wage increase of 3 to 5 cents an hour retroactive to Nov. 1. This is on top of an automatic 5% annual wage increase on the national 5-year contract. Under this contract the wage clause could be reopened after Aug. 1, 1956, and before Jan. 1, 1960, but not more often than at 12-month intervals.

Chance Co Establishes Marketing Division

Marketing Division is the new formation for the former Sales and Order Service Departments of A. B. Chance Co, Centralia, Mo. Included are Market Research, Product Management, Product Distribution, and Export Sales, as well as Field Sales, Advertising and Sales Promotion, Sales Order Service, Power Switching Equipment, and Merchant Products.

Jack Tsbell, vice president in charge of sales, directs the Division. L. C. Hansen is director of marketing. Jack Curtright is sales manager. G. Mayne Daly is manager of product distribution (a new department), and reports to L. C. Hansen.

PD Transformers Outlined in New 40-Page Book

"Preferred Design" power transformers, developed by General Electric Co (EW, May 27, 1957, p 134), are described in a 40-page booklet. Performance data, prices, dimensions and weights are given for typical ratings ranging from 5,000 to 50,000 kva, 69 to 138 kv, with or without load top changing.

The booklet, GEA-6604, entitled Preferred Design Transformers may be obtained by written request to

General Electric Co, Schenectady 5, N. Y.

In this design of transformers, mechanical features and accessories are uniform—those that a nationwide survey showed to have an indicated average acceptance of 86% of power transformer users. An electronic data processing machine helps determine the best combination design variables for any application.

Approved construction drawings are available with every PD proposal. Delivery of PD units is reportedly 6 to 12 weeks less than for "specials" of equivalent rating.

Alcoa Boosts Conductivity of Its Conductors to 62%

Aluminum conductors with minimum conductivity of 62% IACS are now available from Aluminum Co of America. Tensile strength is not reduced, and cost remains the same.

The increase of one percentage point over the present industry standard will, Alcoa reports, enable engineers to assign present-worth cost savings of up to two cents per lb of conductor in transmission losses. The 62%-conductivity metal is supplied in redraw rod, as well as EC grade conductor.

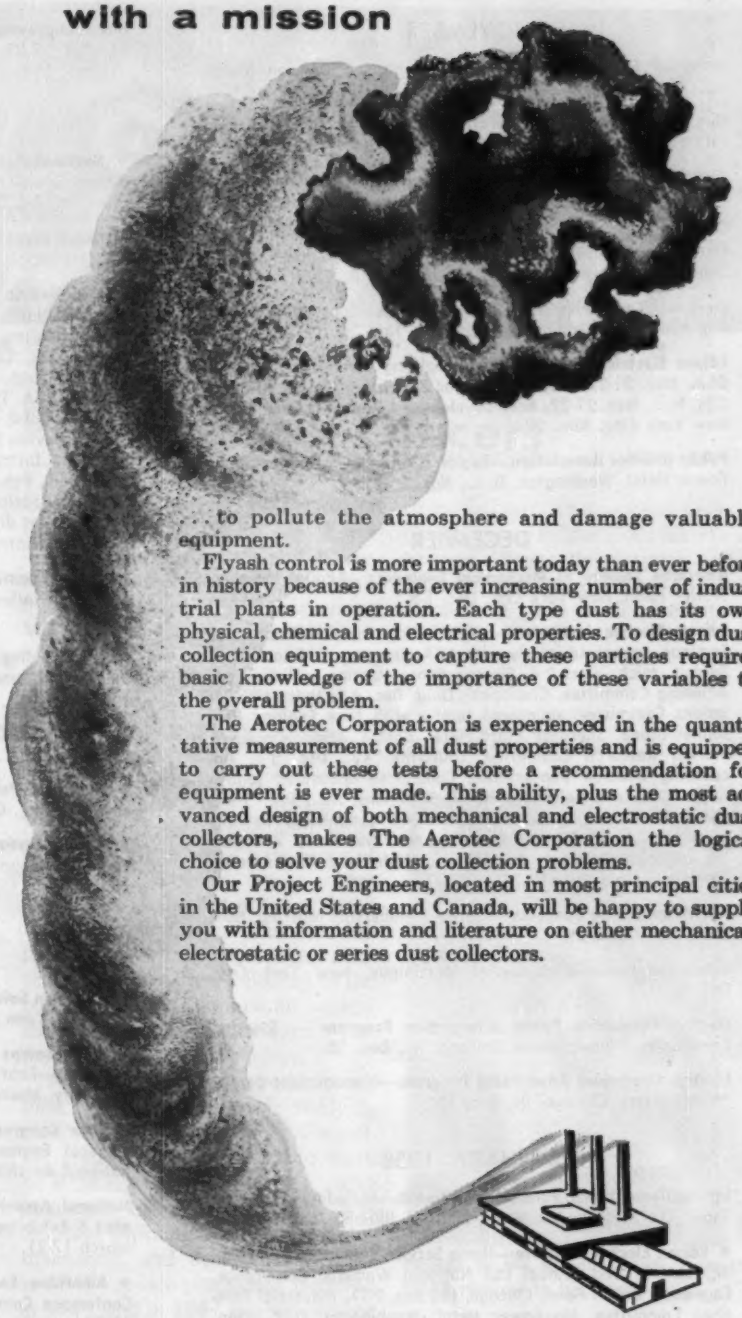
M & M BRIEFS

Osmose Wood Preserving Co of America, Inc, Buffalo, N. Y., has a pole topper fluid, 10% penta solution. This fluid is contained in a 12-oz can, reportedly a sufficient quantity for one pole roof. It is a companion product to the pole topper, a roof protective device.

Hill Transformer Co Inc, San Carlos, Calif., built three autotransformers in 29 days for shipment to Atlas Consolidated, a mining company, in Cebu, Philippine Islands. The units, manufactured to NEMA specifications, were: 4,000 kva, single-phase, OISC, 3810/6600Y-1990/3450Y, with tertiary windings for harmonic suppression.

Dust Particle

with a mission



. . . to pollute the atmosphere and damage valuable equipment.

Flyash control is more important today than ever before in history because of the ever increasing number of industrial plants in operation. Each type dust has its own physical, chemical and electrical properties. To design dust collection equipment to capture these particles requires basic knowledge of the importance of these variables to the overall problem.

The Aerotec Corporation is experienced in the quantitative measurement of all dust properties and is equipped to carry out these tests before a recommendation for equipment is ever made. This ability, plus the most advanced design of both mechanical and electrostatic dust collectors, makes The Aerotec Corporation the logical choice to solve your dust collection problems.

Our Project Engineers, located in most principal cities in the United States and Canada, will be happy to supply you with information and literature on either mechanical, electrostatic or series dust collectors.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.
(Offices in 38 principal cities)
Canadian Affiliates: T. C. CHOWN, LTD., 164 Metcalfe Ave., Westmount, Montreal 6, Que.
Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.

MEETINGS CALENDAR

NOVEMBER

Canadian Electrical Association—Engineering Division Meeting, Macdonald Hotel, Edmonton, Nov. 18-19.

Air Conditioning & Refrigeration Institute—10th Exposition, International Amphitheatre, Chicago, Ill., Nov. 18-21.

American Institute of Electrical Engineers—Conference on Magnetism & Magnetic Materials, Sheraton Park Hotel, Washington, D. C., Nov. 18-21.

Electric Companies Public Information Program—Inter-Regional Committee, Mayflower Hotel, Washington, D. C., Nov. 19.

Electrical Companies Advertising Program—Copy Group Meeting, N. W. Ayer Studio, New York City, Nov. 20.

Edison Electric Institute—Street Lighting Committee, Dayton, Ohio, Nov. 21-22; Industrial Power & Heating Group, Atlantic City, N. J., Nov. 21-22; Area Development Executive Committee, New York City, Nov. 22.

Public Utilities Association—Region II Annual Conference, Mayflower Hotel, Washington, D. C., Nov. 21-22.

DECEMBER

American Society of Mechanical Engineers—Annual Meeting, Statler Hotel, New York City, Dec. 1-6.

Edison Electric Institute — Accounting Division Electronics Seminar, sponsored jointly with AGA, Sheraton Cadillac Hotel, Detroit, Mich., Dec. 2-4; Electric Space Heating and Air Conditioning Committee, Cincinnati, Ohio, Dec. 4-6; Industrial Relations Committee, sponsored jointly with New England Personnel Group, Sheraton Plaza Hotel, Boston, Mass., Dec. 5-6; Market Research Committee, Louisville, Ky., Dec. 5-6; Accounting Division Depreciation Committee sponsored jointly with AGA, Lord Baltimore Hotel, Baltimore, Md., Dec. 9-10; Commercial Cooking & Water Heating Committee, Detroit, Mich., Dec. 12-13; EEI-AGA Customer Activities Group, Accounting Employee Relations Committees, Netherland Hilton Hotel, Cincinnati, Ohio, Dec. 12-13.

American Mining Congress—Annual Membership Meeting, New York, N. Y., Dec. 2.

Interstate Power Club—Hotel Martinique, New York City, Dec. 9.

Electric Companies Public Information Program — Steering Committee, Palmer House, Chicago, Ill., Dec. 10.

Electric Companies Advertising Program—Management Group, Palmer House, Chicago, Ill., Dec. 12.

JANUARY—1958

International Home Furnishings Market—Including Appliance Show, The Merchandise Mart, Chicago, Illinois, January 6-17.

• **Edison Electric Institute**—Home Service Committee, Chicago, Ill., Jan. 8; 2nd Annual LBE National Womens' Conference, Edgewater Beach Hotel, Chicago, Ill., Jan. 9-11; Industrial Relations Committee, Mayflower Hotel, Washington, D. C., Jan. 16-17; Dealer Coordination Committee, EEI Headquarters, New York City, Jan. 30-31.

• **Instrument Society of America**—Boston Section, Yankee Instrument Fair & Symposium, Hotel Bradford, Boston, Mass., Jan. 14-15.

Industrial Heating Equipment Association — Penn Sheraton Hotel, Pittsburgh, Pa., Jan. 27-28.

American Society of Heating and Air-Conditioning Engineers—64th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 27-29.

Home Improvement Products Show—Hotel Sherman, Chicago, Ill., Jan. 27-29.

FEBRUARY

• **National Association of Purchasing Agents**—Public Utility Buyers Group Mid-Winter Meeting, Sheraton Hotel, Philadelphia, Pa., Feb. 2-4.

National Rural Electric Cooperative Association—Annual Meeting, Memorial Auditorium, Dallas, Tex., Feb. 2-6.

Edison Electric Institute — Prime Movers Committee, Penn Sheraton Hotel, Pittsburgh, Penn., Feb. 3-5; Industrial Electrification Heating Conference, co-sponsored by Industrial Electric Council, Cincinnati, Ohio, Feb. 3-6; Industrial Power & Heating Group, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 6-7; EEI-AGA 1958 Conference Final Planning Meeting, Ben Franklin Hotel, Philadelphia, Pa., Electrical Equipment Committee, Dayton Biltmore Hotel, Dayton, Ohio, Feb. 10-11; Transmission & Distribution Committee, Lord Baltimore Hotel; Baltimore, Md., Feb. 11-12; Meter & Service Committee, Sheraton Hotel, Philadelphia, Pa., Feb. 17-19; Industrial Relations Committee, (joint dinner with AGA Personnel Practices Committee) AMA Mid-Winter Personnel Conference, Feb. 20.

American Institute of Electrical Engineers—Winter General Meeting, Statler and Sheraton-McAlpin Hotel, New York City, Feb. 3-7.

Missouri Valley Electric Association—Industrial & Commercial Sales Conference, President Hotel, Kansas City, Missouri, Feb. 6-7.

NATIONAL ELECTRICAL WEEK WILL BE OBSERVED FEBRUARY 9-15.

• **American Public Power Association**—Engineering & Workshop Meeting, Chattanooga, Tenn., Feb. 13-14.

American Institute of Mining, Metallurgical, and Petroleum Engineers—Annual Meeting, Hotel Statler, New York City, Feb. 16-20.

MARCH

• **Southern Safety Conference, Inc**—Exposition; Peabody Hotel, Memphis, Tenn., March 2-4.

Lighting Lamps and Electrical Manufacturers Salesmens Association—First National Lighting Exposition, Coliseum, New York City, March 9-12.

Nuclear Congress—Co-sponsored by American Society of Mechanical Engineers and the Engineers Joint Council, International Amphitheater, Chicago, Ill., March 16-22.

National Association of Corrosion Engineers—Annual Conference & Exhibition, Municipal Auditorium, San Francisco, Calif., March 17-21.

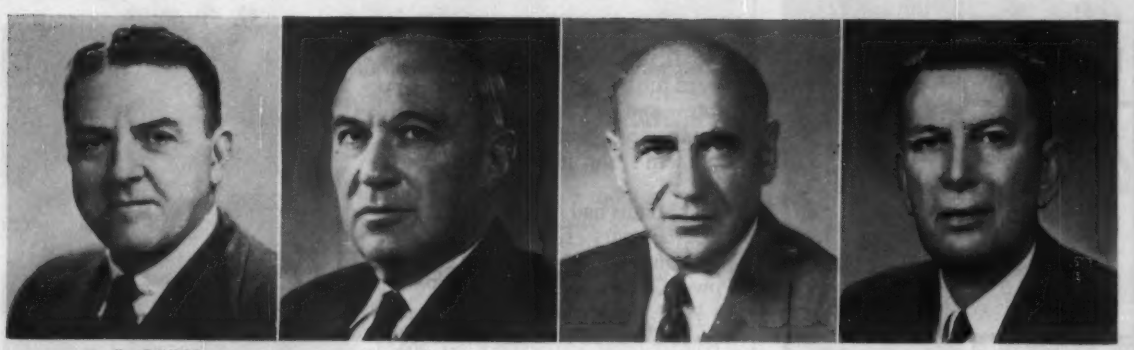
• **American Society of Mechanical Engineers**—Management Conference Committee, Hotel Somerset, Boston, Mass., March 19-20.

Edison Electric Institute—Industrial Relations Committee, Headquarters, New York City, March 20; Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., March 24-27.

American Power Conference—20th Anniversary Meeting, Sherman Hotel, Chicago, Ill., March 26-28.

• **Southeastern Electric Exchange**—Annual Meeting, Boca Raton Hotel and Club, Boca Raton, Fla., March 31-April 2.

• Additions this week.



R. E. GINNA | A. M. BEEBEE | E. J. HOWE | L. H. EAST

Rochester G&E Promotes Six Officers

Robert E. Ginna is the new chairman of the board and chief executive officer of the Rochester Gas and Electric Corp. He succeeds Alexander M. Beebee, who is retiring. Beebee, continuing as a board member, is taking over the executive committee chairmanship.

In other RG&E shifts, Ernest J. Howe replaces Ginna as president, Leo H. East takes over as executive VP, Harold S. Weatherby becomes secretary (replacing retiring Paul J. W. Miller), Paul W. Briggs moves to assistant secretary, and Robert W. Ball, to assistant treasurer.

Ginna's promotion tops a 34-year career with electric, gas, and steam utilities throughout the U. S. After training at the Brooklyn Edison Co, he launched into consulting engineering, and in 1934 joined RG&E as a departmental manager. He has also served as director of the National Assn of Electric Companies and the Public Utilities Public Information Program.

Howe steps up to the presidency after serving as VP and comptroller, and continues as a director and member of the executive committee. His long financial experience started with an MA degree from Columbia University Graduate School of Business in 1923. Sprinkling his business career with government work, Howe has served as financial advisor, Federal Housing Admin.; chief financial advisor, insurance section, Temporary National Economic Committee of the U. S. Senate; and as a member of the New Jersey State Water Policy Commission and N. J. State Local Government Board. He joined RG&E in 1940.

East is also a director and executive committee member, and until becoming executive VP, served as VP-operations. An RG&E man from the start, East worked his way up the career ladder from his job as rodman (during the summer before graduation from the University of Rochester) to cadet engineer, to VP, in 1950.

. . . and Salutes Retiring Beebee

From underground helper to chairman of the board and chief executive officer—that's the story of Alexander Beebee's 41-year career at RG&E. A packed house of 3500 RG&E employees and their families recently watched that career celebrated, along with the history of the company, in the musical variety show, "RG&E Family Album." The cast: 125 RG&E employees.

Alex Beebee's underground work took place while he was studying mechanical engineering at Cornell. He graduated in 1915, set to work at RG&E the next year as a cadet engineer. Five years later he was assistant superintendent of gas manufacturing, and became a director in 1943. A vice presidency followed in 1945, and in 1947 Beebee became RG&E's president. That same year he took on the presidency of Caneadea Power Corp. Last year at RG&E he moved up to chairman of the board and chief executive officer.

A licensed engineer, Beebee has specialized in gas operations. He won the 1938 Beal Medal for the best technical paper of the American Gas Association, and for two years lectured at Massachusetts Institute of Technology on gas manufacturing problems. His lectures were published in several gas journals.

Alex Beebee's other activities have been legion. His chairmanships in the AGA include those of the Post War Planning Committee and Carbonization Committee.

BEEBEE at the bottom: Scene from the RG&E musical in his honor

Illustrated above is No. 11 Tree Pruner with center cut action by tempered steel blade that easily handles 1" branches. Head is reinforced malleable iron. Spruce poles with telescoping aluminum joints. For heavier work No. 12-18, capacity 1½". Also Pole Saws.

for clearing brush...

SEYMOUR SMITH

TIFFANY PRUNERS

No. 530....30"
No. 525....25"

Hand forged throughout. Fast and easy double cut action with thin blades shaped to "draw in." Improved bolt and nut joint, through handle and riveted grip fastening.

FAST-CUTTING SAWS

Blades of Swedish charcoal steel. Large, deep teeth with heavy set to prevent binding. Hand and Pole models for all work up to chain sawing.

Quality Tools
SEYMOUR SMITH
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McManus Fills Southern Co Vacancies

The Southern Co has elected Clifford B. McManus chairman of the board to succeed the late Eugene A. Yates, and has named L. T. Smith, Jr, director. Smith is president of Southern's subsidiary, Gulf Power Co.

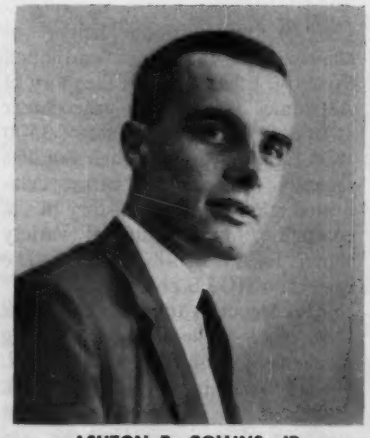
McManus had been vice chairman since January 1, and before that president of Southern and of Georgia Power Co. He joined Georgia Power in 1927, after serving with Alabama Power Co as an engineer and executive.

In 1945 he became assistant to the president and a director, and soon after VP and director of operations. He served as president from 1947 to 1951. In 1949 Southern named him a director, and in 1950, president.

As administrator of the U. S. Defense Electric Power Administration in 1951, McManus had the job of seeing that the nation's electric supply met defense needs.

Smith has been Gulf Power's president since 1955. He joined Gulf in 1926 after superintending the Northern Division of Alabama Power. In 1933 he became Gulf Power's new business manager, in 1942, sales promotion manager, and in 1949, assistant to the general manager. He stepped up to a vice presidency in 1951.

CLIFFORD B. McMANUS



ASHTON B. COLLINS, JR.

EVERETT EASTER

Two Aides Join Reddy Kilowatt

Everett Easter and Ashton B. Collins, Jr, have joined Reddy Kilowatt as assistants to the president.

Easter's advertising agency experience includes three years with Erwin, Wasey and Co, N. Y., and a year with Sparrow Advertising Agency, Birmingham. Since 1954 he has been advertising manager of Tampa Electric Co.

He graduated from Washington and Lee University in 1949, and served three years with the Navy.

Collins joins Reddy Kilowatt after concluding a three-year hitch in the Air Force. He graduated from Cornell University in 1954 with a BA in economics and government, and entered the Air Force as a 2nd lieutenant.

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SEALING COMPOUNDS

PERSONAL BRIEFS

Newly named assistant to the president of Iowa-Illinois Gas & Electric Co is **Robert Hetherington** . . . At Potomac Electric Power Co, **William L. Jones** has retired as vice president after 39 years at PEPCO.

A. A. Lingo heads the newly established steam electric generating department at California Electric Power Co. His assistant is **James N. Zornes.**

Joe G. Terrell has been named to replace retiring **J. A. McCamant** as construction superintendent of Arkansas Power & Light Co . . . At Kentucky Utilities Co, **W. A. Neel** has advanced to London district manager, **J. C. Boston** to Harlan district manager, and **John S. Crosthwait, Jr,** to manager of Big Stone Gap district.

Public Service Co of Indiana, Inc, has named **Lawson E. Williams** district manager at Connersville. Similar posts went to **Jesse L. McKay,** at Greensburg, and **Charles E. Uhl** at Spencer.

Henry W. Henderson has been appointed manager of Alabama Power Co's new Homewood district.

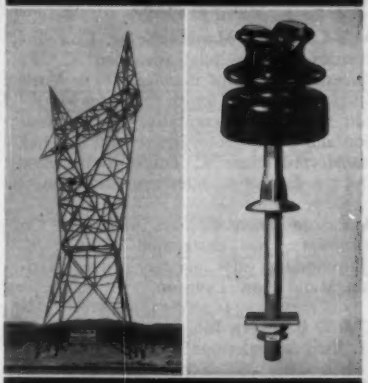
Detroit Edison Co's **L. Clancy Nanry** has been promoted to director of safety to succeed **Robert P. Douglas,** retired.

The Rural Electrification Administration has designated **Leo A. McCarthy** as operations field representative for section 4 of the Northeast Electric area. His territory will cover Michigan, Indiana, Ohio, and West Virginia.

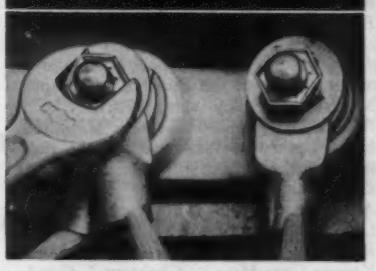
Dr. Thomas H. Johnson, manager of Raytheon Mfg Co's research division, has been elected a vice president . . . Raytheon has named **Russell S. Rockafellow** manager of industrial engineering.

Harold B. Towlson is new manager of engineering for General Electric Co's technical products department . . . The large steam turbine-generator department has appointed **Robert T. Schulenberg** supervisor-machine tool development.

Assemblies stay tight!



Connections stay tight!



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SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co's Industries Group has advanced C. F. Kucera to assistant manager, New York district; Wayne L. Smith to Rocky Mountain regional representative for distribution and transmission equipment; and has transferred Clare K. Tubbs to the new Dayton district as sales representative

American Brass Co, an Anaconda Co subsidiary, has designated William B. Hammond as sales manager of its American Metal Hose Division.

C & D Batteries, Inc, has named Donald G. Ihrig as salesman in Chicago.

General Electric Co's Medium Steam Turbine, Generator, and Gear Dept has realigned its sales operation, with E. K. Nock as acting manager-land sales; and K. A. Drewry, J. A. Urquhart, and M. E. Ferson handling negotiations for apparatus sales for the utility and industrial markets . . . Robert J. Schulte is new manager of the Large Lamp Dept's Mississippi Valley sales district . . . Recently made salesmen in the Miniature Lamp Dept were Wallace E. Berth, Midland sales, Chicago; Elmer E. Garrison, Dixie sales, Atlanta; John Keefe, Jr, Atlantic sales, New York City; Ralph J. Luft, East Central sales, Cincinnati; and James R. Schmidt, West Central sales, Kansas City, Mo . . . Christian J. Goodman, Jr, has been named product sales manager, Semiconductor Products Dept . . . The Silicone Products Dept has advanced John T. Castles to sales manager.

Graybar Electric Co, Inc, has appointed W. J. Goerisch as Atlantic District manager at Philadelphia, effective Jan. 1, 1958. G. L. Call transfers to San Francisco to become Central Pacific district manager on the same date. New district operating manager at Boston as of December 1 will be W. G. Glennon.

Hotpoint Appliance Sales Co has named John F. McDaniel as acting general manager. He continues as general manager of Hotpoint's range and component parts dept.

Hughey & Phillips, manufacturer of tower lighting equipment, has named Donald F. Beechey as sales representative for eastern Canada.

P. R. Mallory & Co, Inc, has appointed T. M. Fitzgerald general sales manager of its Electronic Division, with B. W. Chandler as Eastern regional sales manager and R. H. Andrew as Central regional sales manager . . . In the Metallurgical Division, Paul Hotte is new general sales manager, and J. L. Nichols, A. O. Braun, and D. J. Smith are Eastern, Central, and Midwestern sales managers, respectively. In addition, Fred Hughes was made general sales manager of Electronic Timers Co, a division.

Line Material Industries has designated Donald H. Hugel as fibre conduit specialist with headquarters in Milwaukee.

Philco Corp has advanced George Strotmeyer to regional manager of the Allegheny region and Bruce Lambert to regional manager, Atlantic region.

Rome Cable Corp's new salesmen are Edward M. Groves, in the Cincinnati office; David S. Smith, San Francisco; and C. Blake Duffy, Seattle, Wash.

Simplex Wire & Cable Co has named Richard B. Malton to cover the state of Maine sales area.

Western Precipitation Corp has appointed D. B. Perlis as product sales manager in charge of co-ordinating world wide Dualaire sales.

Westinghouse Electric Corp has advanced Richard D. Fang to manager of the Albany branch office, northeastern apparatus sales region. He succeeds W. B. Cone, now assistant to the manager of agency and construction sales in Pittsburgh.

Weston Electrical Instrument Corp, a subsidiary of Daystrom, Inc, has appointed Emil Nichols manager of test equipment sales; A. R. Walthers manager of tachometer sales, and Paul M. Heilman distributor sales manager.

REPRESENTATIVES

Allis-Chalmers Manufacturing Co has named Barker-Fowler Electric Co as distributor for A-C motors and control in Ingham, Eaton, Shiawassee, and Clinton counties, Mich. . . . New distributor for feeder voltage regulators and power transformers in most of Mississippi is Cabell Electric Co, Jackson . . . Tennessee Valley Electric Supply Co has been named agency for A-C feeder voltage regulators, power transformers, unit substations, switchgear, and circuit breakers in the Memphis area.

Curtis Lighting, Inc, has appointed Dupont-Wachter & Co as sales representative in the New Orleans area . . . Hawn & Stear, Inc, now represents Curtis in the Pittsburgh and West Virginia area through W. Myrton Hawn and Ralph H. Stear, respectively.

Lake Shore Electric Co has named the following representatives: Herbert J. Baer Co of Richmond, to cover Virginia; C. B. Rogers Co of Clearwater, for Florida; Hurbert Kaub of Denver, for Montana, Wyoming, Colorado, and New Mexico; Davis Sales Co of St. Paul, for Wisconsin, Minnesota, Iowa, North and South Dakota; and Roger Allen, C. B. Rogers & Associates, of Atlanta, for Georgia and South Carolina.

Westinghouse Electric Corp has designated Northern Supply, Inc, of Anchorage, Alaska, as an agent-distributor.

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3—1000 KVA Penn 33000-2500/4330Y
3— 500 KVA W-H 33000-2400/4160Y
3— 500 KVA G-E 22000-2300/4000Y
3— 500 KVA W-H 13200-2300/3985Y
3— 333 KVA Mol 33000-7200/12470Y
3— 333 KVA W-H 13800-240/480
3— 333 KVA Mol 2300/4000Y-230x460
3— 250 KVA W-H 22000-7200/12470Y
3— 200 KVA A-Ch 34500-2400/7200
6— 150 KVA W-H 2400-120/240
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3	200	West.	44,000—480
2	3000	Stand.	33,000—4160, 3 Ph.
4	1667	West.	34,500—7200, Inertaire
2	1500	G.E.	34,400—2520, 3 Ph.
3	200	A.C.	34,500—2400/7200/12470Y
3	75	Wag.	33,000—240/480
1	3000	A.C.	25,380—2500/4330Y, 3 Ph.
3	2000	A.C.	26,400/13,200—2390/4140
3	1250	G.E.	26,400/13,200—2400/4150
3	1500	G.E.	23,000—2400/4800, 3 Ph.
3	100	G.E.	22,000—7200/12470Y
3	50	G.E.	22,000—2300
3	1667	G.E.	13,800—600
1	600	Stand.	13,200—2300, 3 Ph.
1	450	Penna.	13,200—2400, 3 Ph. Askarel
3	200	G.E.	13,200—2400
3	125	A.C.	6900—2306
3	100	G.E.	4800—120/240
3	50	Mal.	4160/7200—240/480
3	1500	G.E.	2300/4000—460
3	500	West.	2400/4160Y—240/480
3	150	West.	2400/230/115
3	100	G.E.	2300/4000—230/460
1	100	G.E.	2300—575, 3 Ph.
6	50	West.	2400—114/228, Dry Type
3	25	G.E.	480—120/240

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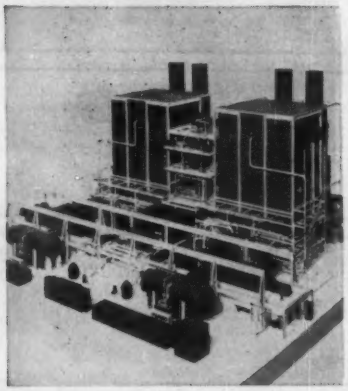

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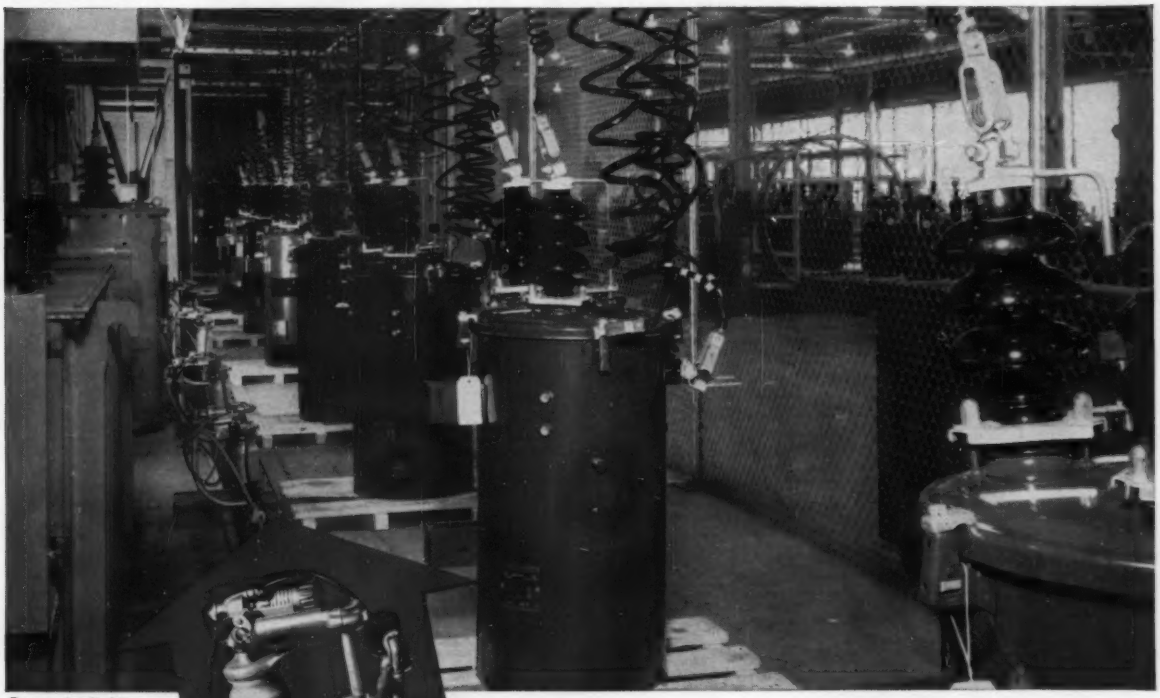

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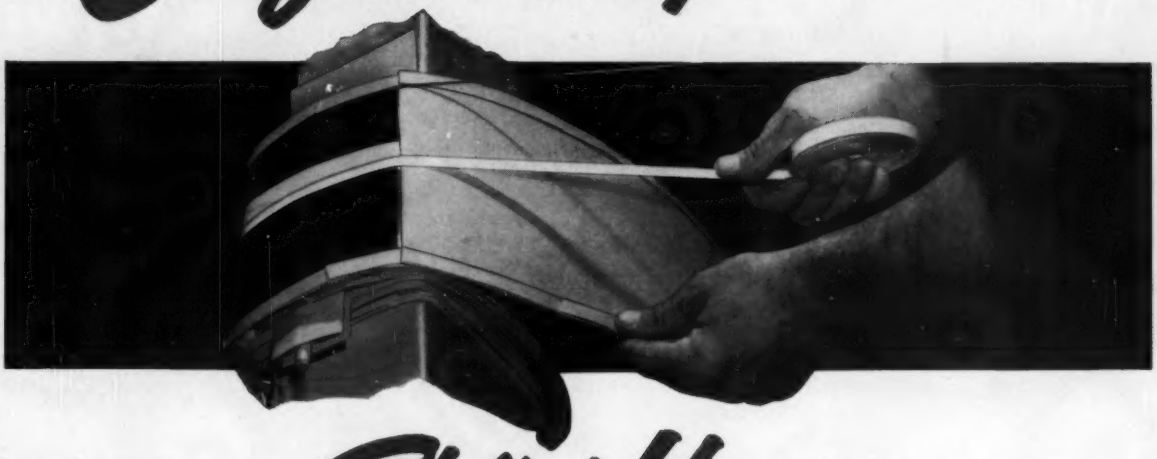

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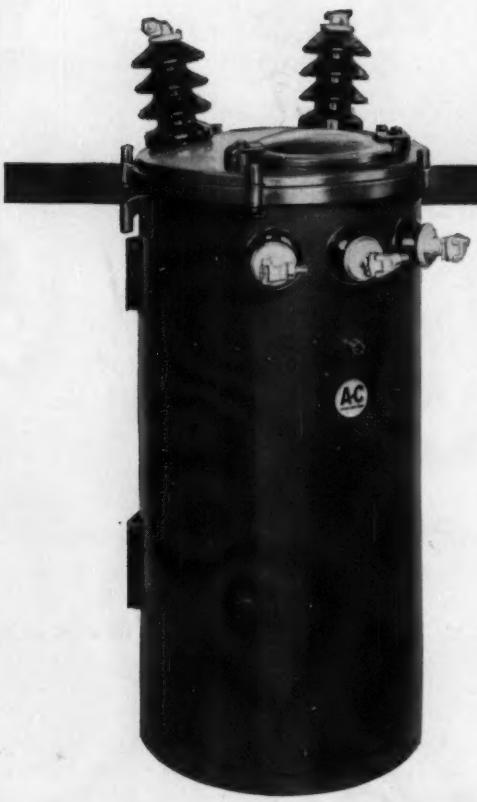

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